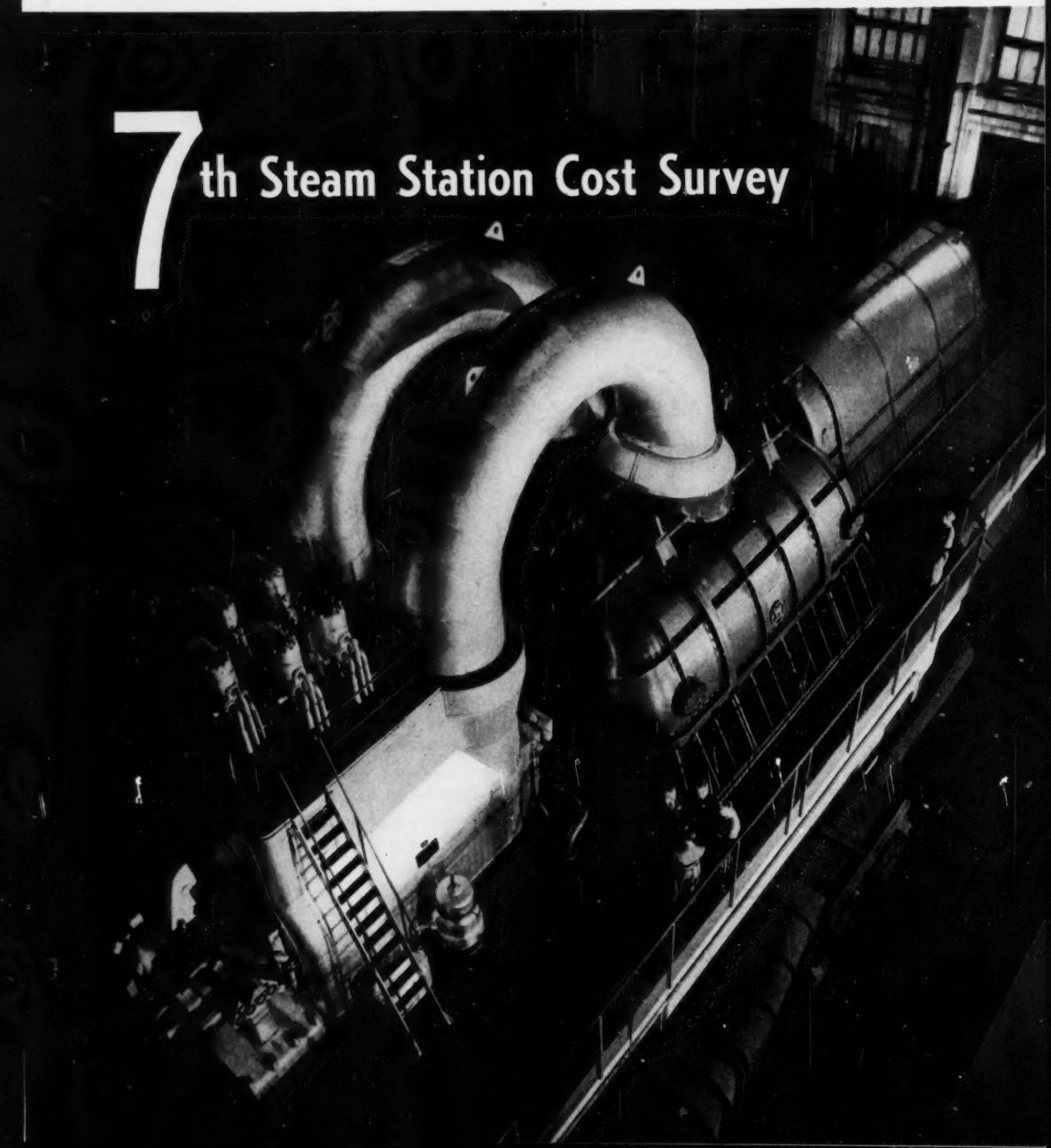
AUGUST 27, 1951

Electrical World

Price 35 Cents

A McGRAW-HILL PUBLICATION

7th Steam Station Cost Survey



Murray — the Circuit Breaker that has a special advantage

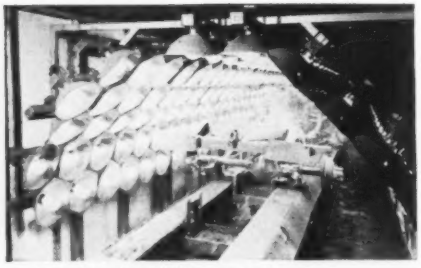
Fully Magnetic!

Where it's HOT

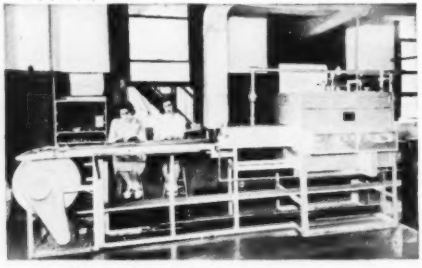
IT CARRIES FULL LOAD REGARDLESS OF TEMPERATURE

Circuit protection is provided entirely by magnetic action. Because Murray Circuit Breakers are fully magnetic, they trip only on short-circuits and dangerous overloads. They always carry the full load, regardless of temperature. They never need "derating."

Where it's HOT



An Infra-Red Baking Tunnel



An Electric Brazing Furnace

Murray Circuit Breakers are ideal under *all* conditions and especially *where it's hot*. In every plant and power company there are places where a Murray Magnetic Circuit Breaker is a *must*: boiler rooms, furnace rooms and near Infra-Red Banks, Induction Heating Coils, Annealing Furnaces, Soldering Pots, Baking Ovens and Tunnels, Radiant Heaters, Convection Heaters, Drying Chambers, Brazing Furnaces. If you have these, or any similar conditions, make sure your protective equipment will carry full load at all times – Use Murray Fully Magnetic Circuit Breakers.

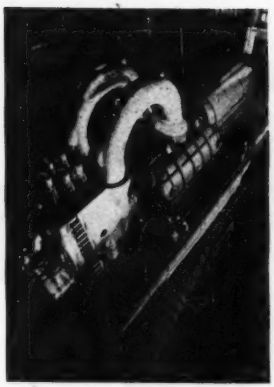
IF YOU WANT TO INSTALL THE BEST... specify Murray

Murray®

MURRAY MANUFACTURING CORPORATION
1250 ATLANTIC AVENUE • BROOKLYN 16, NEW YORK

Service Entrance & Meter Equipment · Magnetic Circuit Breakers · Switches
Current Limiting Reactors · Crows'nest Aerial Ladders

"COVER GIRL"



The big turbine-generator above has many distinctions besides appearing on the cover of Electrical World. With a capacity of 165,000 kw, it is one of the largest generators in the world. At Philadelphia Electric Company's Richmond Station it has just completed 16 years of service and hung up an all-time record for producing electricity.

In its lifetime it has produced nearly 15 billion kwhr of electricity, equal to the electrical needs for one year of 7½ million present day homes.

FORECAST ISSUE

As most industry men have long known, the key to utility expansion in 1952 lies in copper and structural steel. Allocations will surely set limits on capacity additions and other capital expenditures. Authorities expect a heavy cut-back to postpone adequate reserve margins for at least another year.

Meanwhile, increased operating expenses have taken a big bite out of earnings and brought on numerous rate increases—and warnings of more to come.

What does 1952 hold? As accurately as a thorough analysis of economics, government and industry figures can predict, the answer is in Electrical World's Forecast Issue, coming September 10. The efforts of Electrical World's staff, together with McGraw-Hill's Department of Economics and Washington Headquarters staff all combine on the best possible measurement of the year ahead.

Electrical World

Published for 77 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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Day in--Day out DEPENDABILITY...

Year in--Year out ECONOMY...

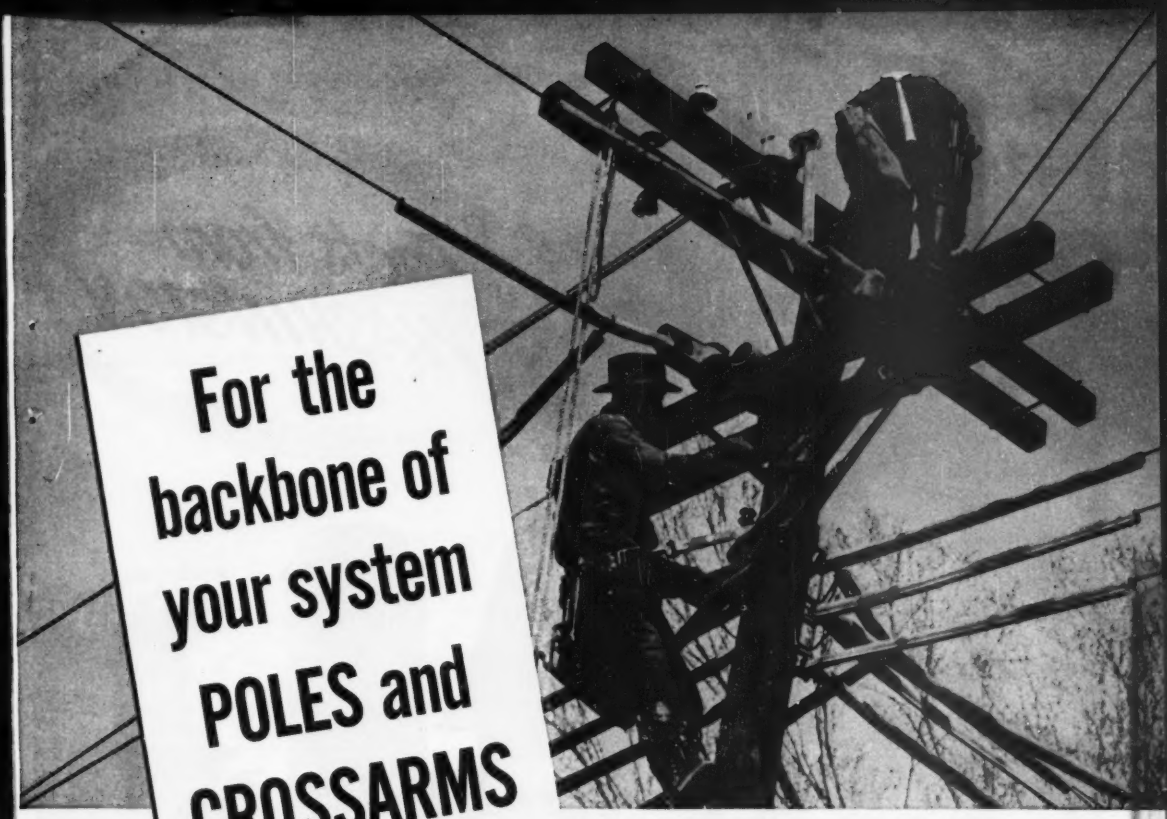
HAZARD WATERTITE-HAZAPRENE® CONTROL CABLES

Assurance of day in and day out maintenance-free performance makes Hazard Watertite-Hazaprene cable construction ideal for control circuits. From the inside out — from the corrosion-resistant Hazaloy coated conductors to the rugged Hazaprene sheath — Hazard Watertite-Hazaprene is engineered for long-lived economy.

Watertite-Hazaprene amply meets the exacting requirements of control cable service. Rubber fillers prevent the wicking-in of moisture . . . firm, electrically strong, long-lived Watertite rubber insulation prevents deformation . . . the tire-tough Hazaprene ZBF sheath offers superior resistance to flame, oil, acid, alkali, sunlight, moisture and mechanical damage. The ZBF sheath is a research-developed, service-tested protective covering, compounded of neoprene to Hazard's special Zinc Borate Formula; it is pressure-vulcanized in a continuous lead sheath to give a smooth, dense surface that resists abrasion and tearing.

There's a Watertite-Hazaprene Cable for every control circuit requirement. For further information about these dependable, money-saving control cables, write to Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

HAZARD



For the backbone of your system POLES and CROSSARMS

Via GraybaR

The pole-line backbone that supports today's essential power lines needs seasoned strength and durability to do its job efficiently and at low maintenance cost.

That's one reason why power companies all over the nation choose Graybar for all their pole-line needs. They know that Graybar-distributed materials are always right for the job and stand up under abnormal stress of storms, ice, and snow.

POLES—Differing conditions lead to different local preferences. That's why Graybar distributes *all* types of poles—full-length, pressure-treated Southern Pine . . . full-length, pressure-treated Fir and Cedar . . . butt-treated Northern and Western Cedar.

All treated poles are carefully selected and processed to provide maximum strength and durability—plus the clean, smooth exterior surface required for city use.

CROSSARMS—Douglas fir crossarms via Graybar are selected and seasoned under rigid methods—are strong, long-lasting, and provide a wide margin of safety in the line.

POLE-LINE SUPPLIES—Graybar also distributes insulators, wire, cable, strand, hardware, tools, and hundreds of other needed pole-line supplies—all products of outstanding manufacturers.

To keep the backbone of your system strong, order your supplies from Graybar. You'll always get dependable items, and the nationwide Graybar warehouse system helps assure the *fastest possible* deliveries under today's uncertain conditions.

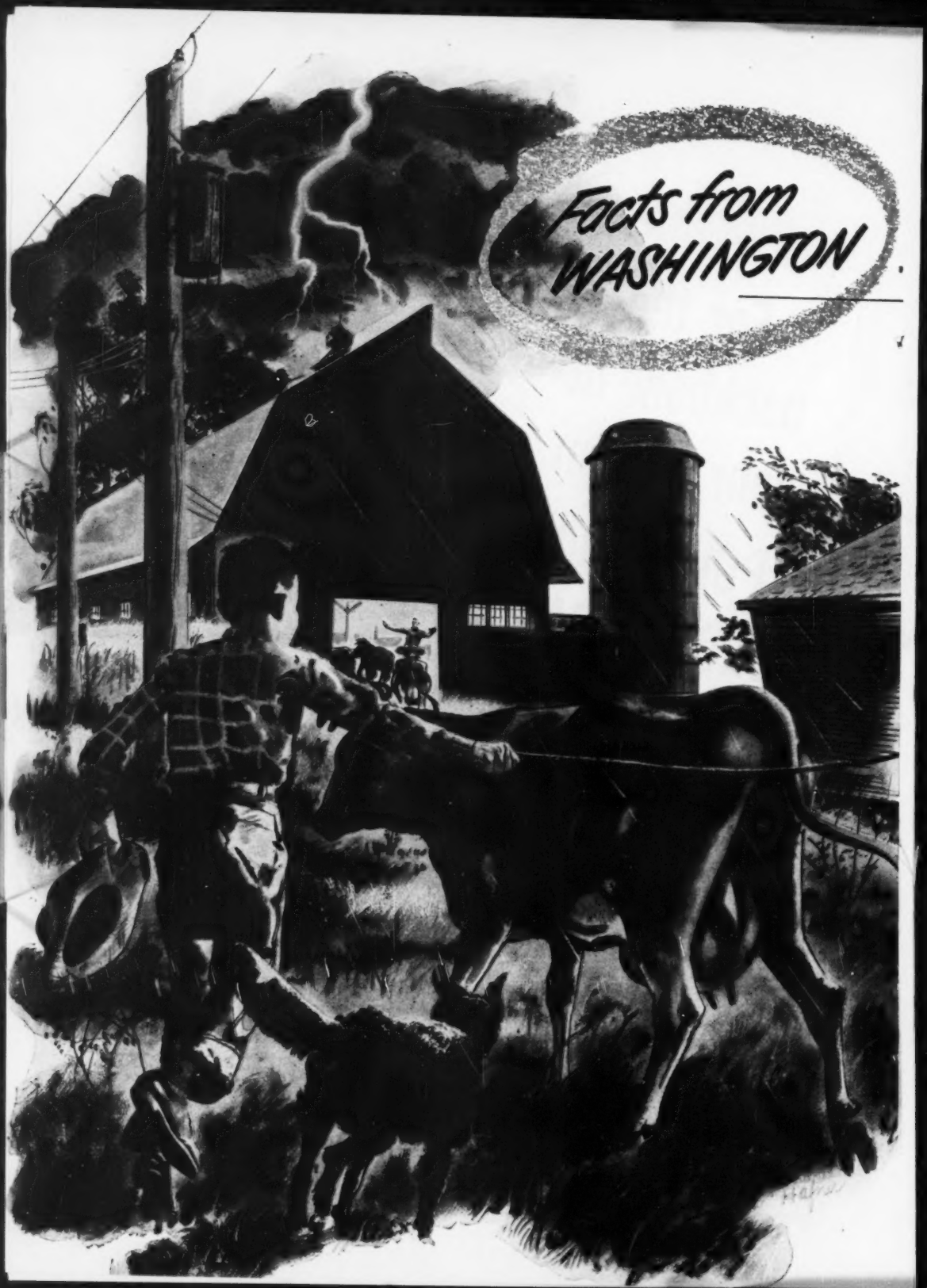
Because Graybar is wholly owned by its operating and retired personnel, you can always expect an extra measure of personal interest in serving you. Feel free to call your local Graybar Representative for information on any electrical item . . . call your nearby Graybar Outside Construction Specialist for planning aid and technical advice.

Graybar Electric Company, Inc. Executive Offices: Graybar Building, New York 17, N. Y.

148-98

Everything for your pole lines
Via GraybaR

IN OVER 100 PRINCIPAL CITIES


Facts from
WASHINGTON

"Single 'CSP' Transformer saves us $59.20 per year"

"One 'CSP' transformer is saving us an average of eight service calls a year —at a cost of at least $7.40 per trip," reports a utility in Washington State.

"In a rather inaccessible location, we had a conventional distribution transformer at the end of a rural line. Ten years' experience indicated that it cost us an average of $59.20 per year to maintain service at this troublesome spot. In addition, each outage averaged over two hours' duration . . . a cause of considerable customer irritation.

"Three years ago we replaced it with a 'CSP' transformer. Soon afterward a severe electrical storm damaged 18 conventional transformers in the same area, but left the 'CSP' transformer untouched in the location that had been the worst offender. To date this 'CSP' transformer has not had a single 'outage'."

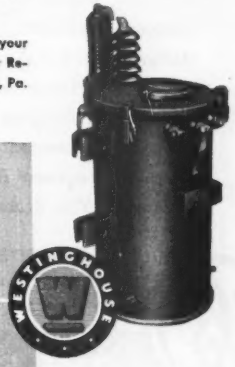
Installation and maintenance costs for Westinghouse "CSP" (Completely Self-Protecting) Transformers are always lower, because complete protective equipment is built in, not separately mounted. A two-year survey of Electric Light and Power Companies shows the following: J-70595

NATIONAL AVERAGES

	"CSP"	Conventional
Installation Costs	$13.87	$24.74
Burn-out Rate	0.257%	1.005%
Fuse Outages	None	5.64% @ $6.52 per outage
Load Checks	Automatic	12.8%
Breaker Reset	1.02%	None

If you'd like to check your own costs against these national averages, ask your Westinghouse representative for Booklet 4-247-B, "Transformer Costs and Their Relation to Profits", Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

"CSP" devices . . . originated and patented by Westinghouse

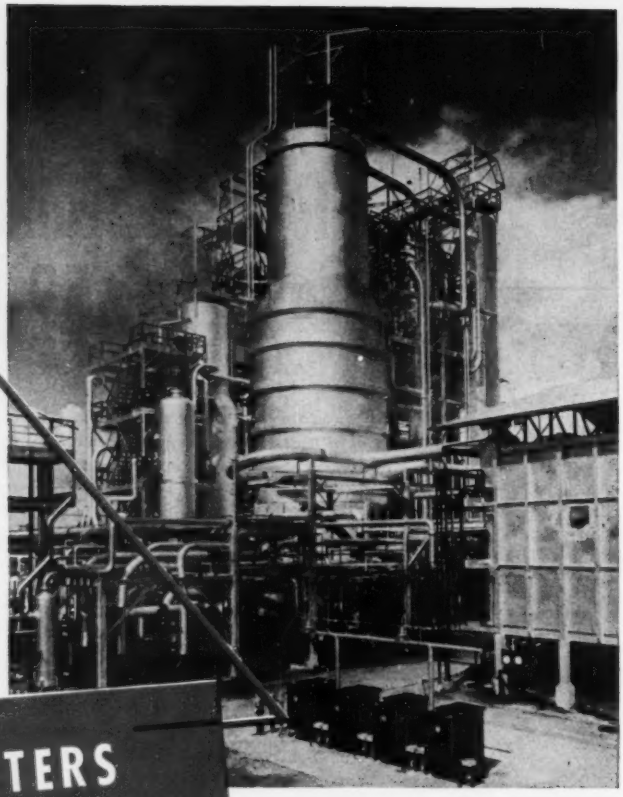


YOU CAN BE SURE.. IF IT'S

Westinghouse

"CSP" DISTRIBUTION TRANSFORMERS

EC&M Bulletin 1062 Type ZHS 2300 Volt Motor Starter in Type VIII enclosure for Class I, Group D hazardous atmospheric locations.



Photograph—Courtesy, Foster-Wheeler Corp., designers and constructors of this 48,000 barrels per day, 3-stage crude distillation unit.

EC&M STARTERS
for 2300 Volt Motors
HELP BOOST PETROLEUM PRODUCTION

Oil immersion of the Type ZHS heavy-duty Magnetic Contactor in the rear tank of the starter permits making and breaking the main motor circuit under oil. The oil also keeps the mechanism well lubricated and corrosion protected—*eliminating the need for frequent inspection or maintenance.* The drain pipe with shut-off valve terminates at the front under the conduit connection box in which the overload relays are mounted.

EC&M Type ZHS Starters for *2300-4600 volt motors* are built in 50,000 KVA interrupting capacity and in the VALIMITOR (volt-ampere-limitor) style for use on power systems having up to infinite KVA.

***WRITE FOR* Bulletin 1062 and No. 23 *Accelerator* Bulletin describing EC&M 2300—4600 volt motor starters.**

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

RIVER AT WORK

• Big Creek 4, 84,000 K.W. hydro-electric powerhouse, on the San Joaquin River, California. Completed 1951, Southern California Edison Company, owner.

Bechtel provides a complete and integrated service—design, engineering, purchasing, construction. All principal types of power generation—hydro-electric, steam and diesel—and transmission and distribution facilities are included in work now in progress or recently completed.

Our experience and organization furnish the ideal combination for your next project.

BECHTEL CORPORATION

"BUILDERS FOR INDUSTRY"

Los Angeles • **SAN FRANCISCO** • *New York*

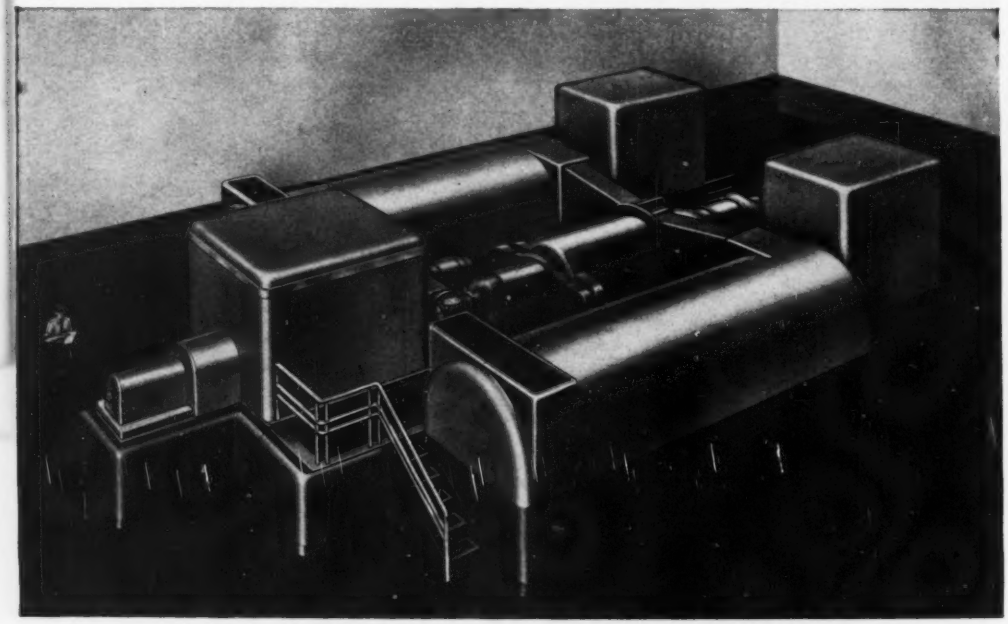
NEW WAY TO HANDLE DEMAND

Power companies, compelled to meet sudden new load demands from defense industries in outlying territories, may find the answer to their problem in the simplicity of General Electric gas turbines. Gas turbines, though they stand on their own feet as far as economy of power generation is concerned, also offer unique advantages for service in end-of-the-line plants.

For example, a gas turbine is easily and quickly installed. There's no massive foundation to worry about, and the building which houses the unit can be of the simplest construction. Furthermore, a gas turbine-generator is easy to operate—it offers the excellent possibility of modification for remote operation in the future. If load demands change, the design of the gas turbine makes moving to a new location a practical, inexpensive operation.

Several utilities, recognizing these distinctive gas turbine advantages, have ordered units to firm up service in outlying territories. If you have a similar problem, why not investigate this possibility yourself? A General Electric turbine specialist in your nearby sales office will discuss the application in the light of your requirement. And, if you'd like a copy of our 28-page bulletin describing gas turbines, write to General Electric Company, Schenectady 5, N. Y., for GEA-5516, "Gas Turbine Power Plants."

GAS TURBINES

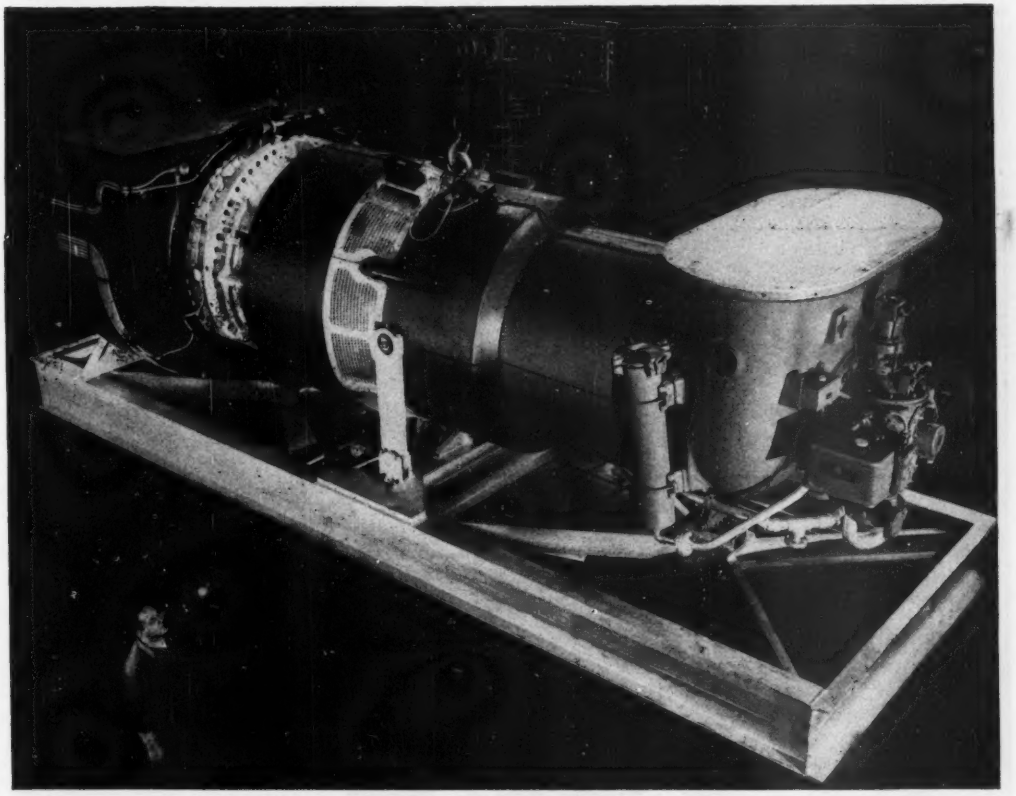


A COMPLETE POWER PLANT is yours with the compound-cycle gas turbine illustrated here. It is delivered with regenerator and intercooler and requires a minimum amount of cooling water.

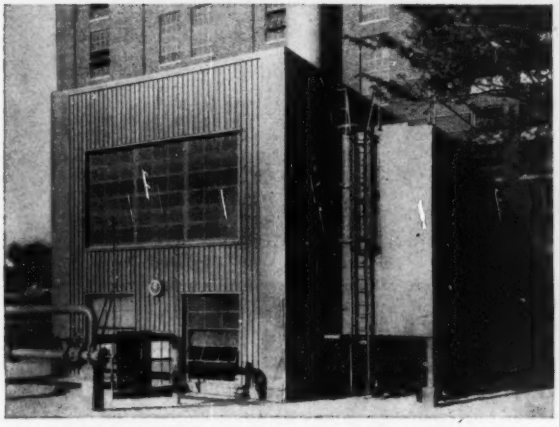
GENERAL ELECTRIC

255-4

AT THE END OF THE LINE



EASY INSTALLATION is possible because of the compact design and relative light weight of the gas turbine. The components of the simple-cycle unit can be easily handled for inspection and assembly purposes.



THE SIMPLE BUILDING AND FOUNDATION required for a gas turbine installation makes possible substantial savings in initial cost for end-of-the-line plants. In this building, the gas turbine rests on a reinforced concrete slab.

EASE OF OPERATION is a big factor in end-of-the-line plants. The control unit shown here contains all instrumentation and control equipment for operation of the turbine.

Valves can be operated the hard way, too...

but —

LIMITORQUE® PUSH BUTTON OPERATION

...is cheaper, safer, automatic, positive and dependable

LimiTorques are available for all types of valves and may be supplied for actuation by any power source such as electricity, steam, gas, oil or air. Write for LimiTorque catalog L-50 on your business letterhead.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
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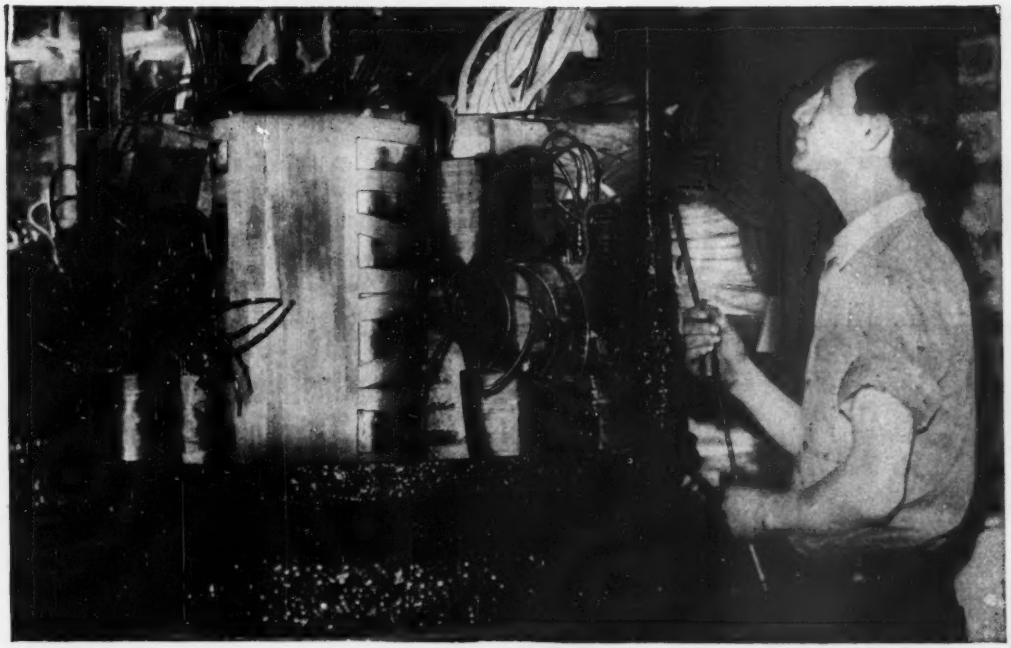
Industrial Gears and Speed Reducers
LimiTorque Valve Controls



Marcus Transformer Co. has used HARVEL 912-C for years . . . "FOR TOP-QUALITY INSULATION AT MODERATE COST"

A consistent user of Harvel Internal Curing Varnishes ever since 1936, Marcus Transformer Co., Hillside, N. J.—one of the world's largest manufacturers of dry type transformers—naturally investigated Harvel 912-C as soon as Irvington Varnish & Insulator Company placed this product on the market.

Result: Marcus has been using 912-C ever since—to the complete satisfaction of Marcus *and Marcus customers.*

Reasons: Harvel 912-C bonds conductors firmly into a solid, compact mass—has a dielectric strength of 2200 vpm—*retains* its excellent mechanical and electrical properties even at elevated temperatures.

Other advantages: Harvel 912-C gives equally outstanding performance in other types of transformers or in rotating machinery—because it is completely oilproof . . . free from soft, tacky interiors . . . ideal for high peripheral speeds.

You can get all these features—and speed up your production *too*—when you use Harvel 912-C. In many cases, its fast curing properties cut baking time in half! The full story on Harvel 912-C is yours for the asking—just fill out the coupon below.

Send this convenient coupon now

Irvington

VARNISH & INSULATOR COMPANY

Irvington 11, New Jersey

EWO-8/51

Irvington Varnish & Insulator Company
6C Argyle Terrace, Irvington 11, N. J.

Gentlemen:

Please send me technical literature on Harvel 912-C Internal Curing Insulating Varnish.

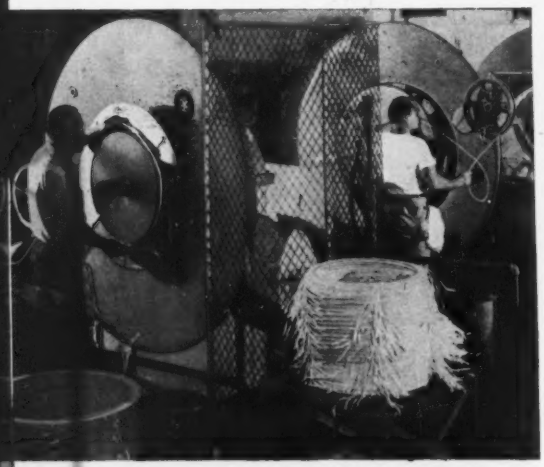
Name_____

Company_____

Street_____

City_____ Zone_____ State_____

MORE POWER FOR AUTO ASSEMBLY PLANT



These special machines wind a pair of high voltage disc coils simultaneously with uniform tightness from a continuous conductor. This method eliminates connections at the center of the double coil. Coils are stacked, clamped, and brazed together. Uniformly placed spacers are cemented between the coils, giving good mechanical support without impeding circulation of the coolant.

Consumers Power Company of Michigan Installs Two More Allis-Chalmers Transformers Into State-Wide System

POWER TO RUN machine tools and motors, to move assembly lines . . . power to produce thousands of automobiles each week is supplied by this pair of 10,000 kva Allis-Chalmers transformers. They supply economical power for a large auto manufacturing and assembly plant in Michigan.

These transformers, installed by Consumers Power Company, are designed to have a low rate of depreciation and low maintenance cost. For over a quarter of a century, Allis-Chalmers power and distribution transformers have met the exacting standards of the Consumers Power Company's statewide system that supplies 1,000,000 kw to 56 Michigan counties. These new transformers will help make satisfied customers for years to come.

Because they're equipped with protective inert gas system (which preserves the high dielectric strength of the oil and minimizes filtering requirements) sludge and acid formation is retarded. They're electrically designed for proper stress protection . . . high and low voltage windings, coils and leads are strongly supported and securely braced against repeated short circuits. Specially designed radiator gaskets eliminate leakage.

These are just some of the reasons why Allis-Chalmers transformers are doing a good job of power distribution for the nation's progressive electric power producers like Consumers Power Company. Whether standard or special designs, Allis-Chalmers can produce the specific transformer for your system.

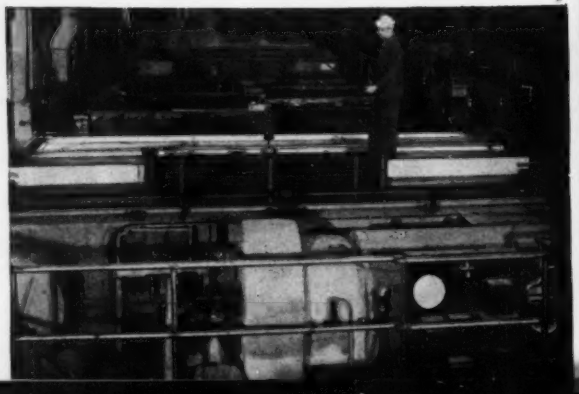
Why not call in your A-C sales representative for more information on Allis-Chalmers power transformers? Offices in 64 principal cities. Allis-Chalmers, Milwaukee 1, Wis.

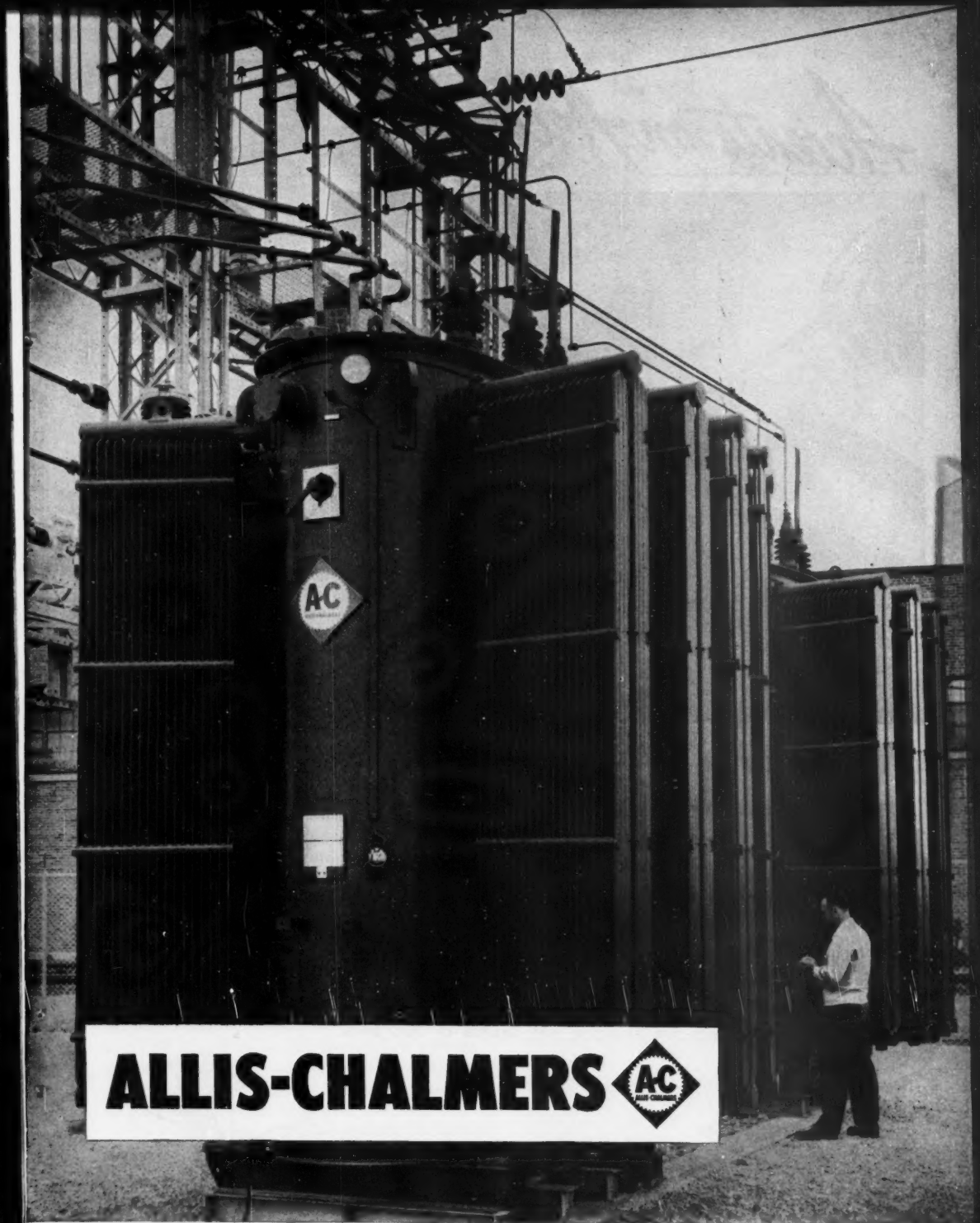
A-3387

Two of eight ovens designed specially for high velocity drying. Air is completely circulated every two minutes and changed every four minutes. The core and coil assembly is baked until completely dried and checked by power factor and megger readings. After drying, all bolts are tightened and the assembly is immediately placed in insulating liquid in its own tank.

Radiators are made corrosion-resistant by a 5-step bonderizing process and then rotary flow painted.

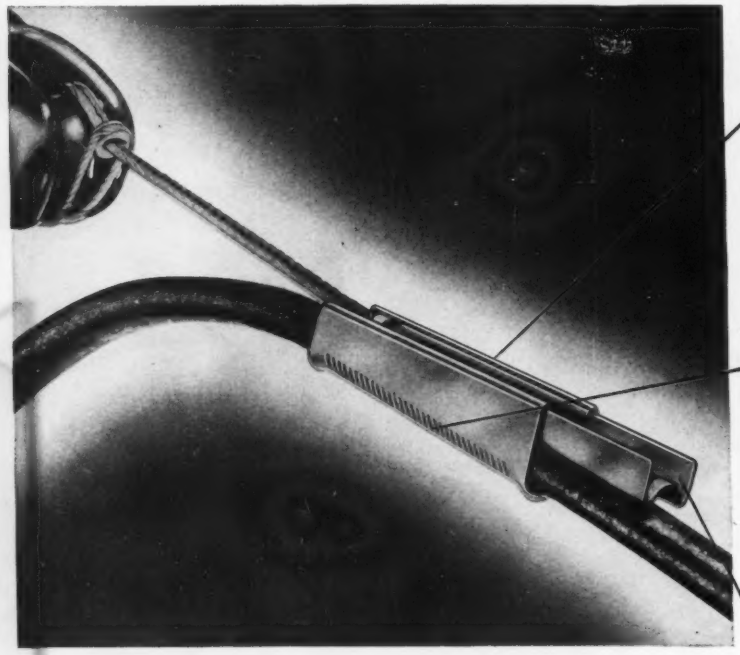
On the right is a radiator being hoisted from the oven after baking for 15 minutes at 350°F. This produces a smooth, tough surface that resists industrial atmospheres and severe climatic conditions.





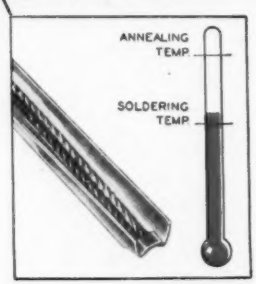
Two 10,000 kva 3 phase, 60 cycle, 55° C rise, positive pressure inert gas equipped outdoor transformers installed by Consumers Power Company at Pontiac substation. Soon to be added is a 30,000 kva Allis-Chalmers power transformer at Erie.

Accents on Accuracy



1. Rails of wedges and shells are held closely parallel to assure that application of pressure to cable is evenly distributed.

2. Rails of wedges and shells are formed to provide a minimum of friction between cooperating surfaces, to assure proper tightening under load.



3. Bails are soldered to wedges without annealing, to retain maximum strength of joint.

in the manufacture of

CONCENTRIC CABLE CLAMPS

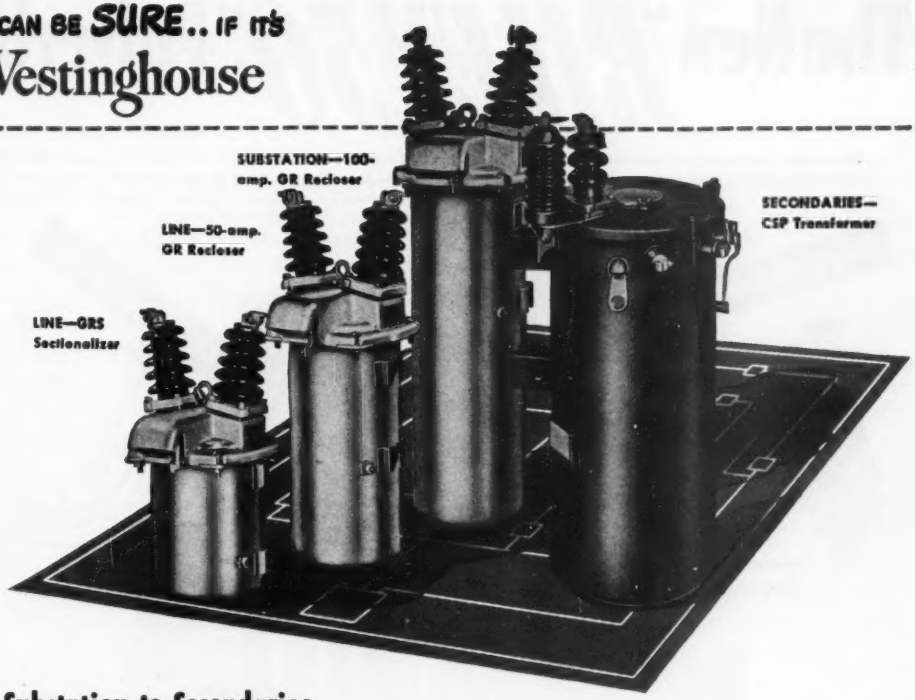
The area of the clamping surfaces designed into Reliable Concentric Cable Clamps prevents snubbing of the cable over a small radius with its consequent opening of the braid and also minimizes wear. Tightening automatically under load it retains its grip even if the cable shrinks. Cable does not have to be threaded through the clamp. It is possible to put up and sag the cable before cutting. Reliable Concentric Cable Clamps are available with flexible or solid bails.

POWER-LINE CONNECTORS
AND
CONSTRUCTION SPECIALTIES

Reliable ELECTRIC COMPANY
3145 CARROLL AVENUE, CHICAGO 12, ILLINOIS
OVER 40 YEARS OF SERVICE TO THE UTILITIES

YOU CAN BE **SURE**.. IF IT'S

Westinghouse



From Substation to Secondaries...

COMPLETELY MECHANICAL SYSTEM PROTECTION

...for lower, long-term distribution costs!

In this case, "mechanical" means a *fuseless* protective system... and one which promises many long-term, cost-saving advantages for rural and suburban lines. Specifically, it's a system which eliminates fuse replacement costs; which stays in proper co-ordination *permanently;* which simplifies the job of re-energizing faulted lines.

Its basic elements are those pictured above. The new Westinghouse GRS Sectionalizer, which is used in place of fuses, is its key component. Co-ordinated with substation reclosers, line reclosers and CSP Transformers, the sectionalizer permits—for the first time—attainment of a completely automatic, mechanical protective system . . . a *sure* way to gain this important objective:

The highest degree of service continuity at the lowest long-term cost!

The mechanical protective system is one of those analyzed in Booklet B-4700, which covers advantages, limitations and cost considerations of all types of protective schemes for rural and suburban lines. For your copy of this practical guide to better protection planning, write: Westinghouse Electric Corp., P.O. Box 868, Pittsburgh30, Pa.

J-60738

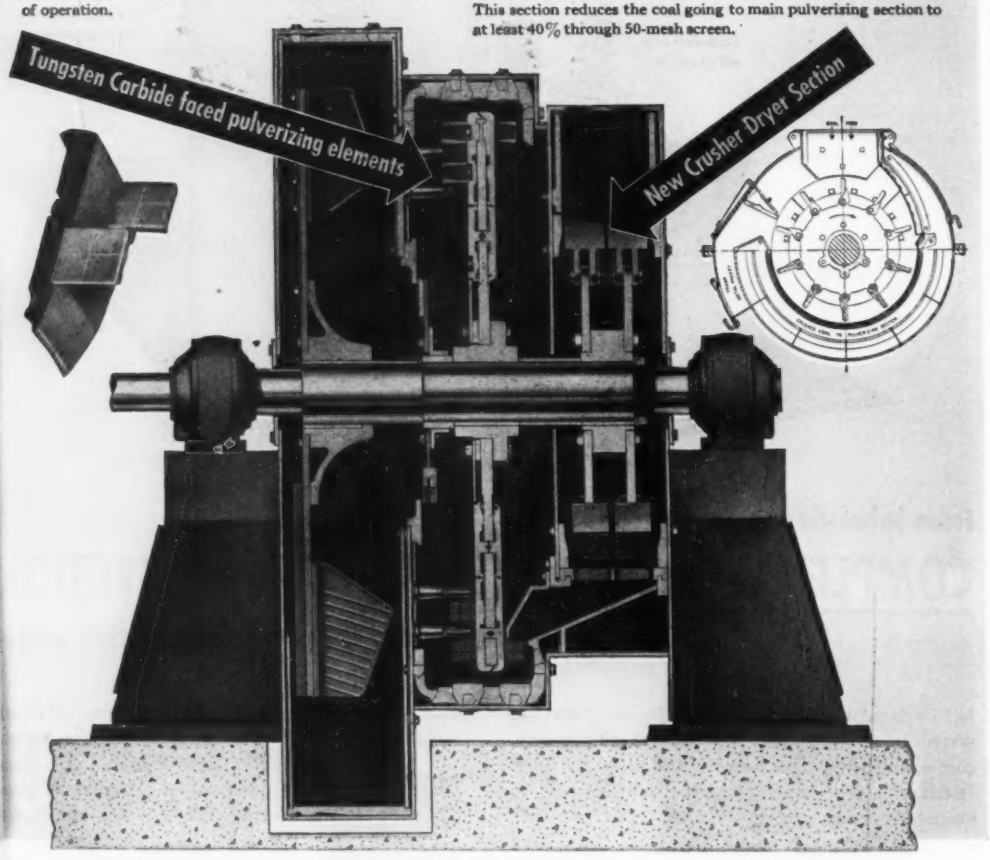
Westinghouse

DISTRIBUTION APPARATUS

The New "RILEY 50" Pulverizer

Gives long uninterrupted operation, low maintenance and sustained fineness over years of operation.

Where the free moisture is evaporated—no capacity reduction with high moisture—where foreign materials in coal are rejected. This section reduces the coal going to main pulverizing section to at least 40% through 50-mesh screen.



We can merely touch on the many operating advantages of the new Riley "50" pulverizer in a two-page ad. The Riley "50" is the most significant pulverizer development in the past decade. Write for the story of the Riley "50." It will pay you to thoroughly investigate the Riley "50" before purchasing coal pulverizers.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston Denver
Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Spontaneously Accepted by Engineers

Because of These Outstanding Features

*1 No capacity reduction with increase in moisture.

2 Tramp iron, iron pyrites and other foreign materials in coal rejected.

*3 Pulverizing elements faced with tungsten carbide.

4 Fineness sustained over years of operation.

5 Long periods of operation without necessity of shutdowns.

*6 Unusually high capacity per unit of space.

*7 Minimum foundation requirements.

*8 Ability to carry low loads.

9 Flexibility-wide load range.

*10 Operates without coal, with no noise and without wear or damage to parts.

11 Low maintenance and power.

*12 No explosion hazard, travel of coal through pulverizer faster than flame propagation.

*13 Quiet vibrationless operation.

*14 Ease of lighting and regulation.

15 High primary air temperatures.

16 Thoroughly dependable.

*17 Negligible cost of lubrication.

*18 All moving parts on a single horizontal shaft with bearings outside of housing. No worms or gears.

*19 Primary air fan integral with pulverizer —separate fan and motor not required.

No other pulverizer can approach the Riley "50" in these important characteristics.

All of these companies have ordered Riley "50" Series pulverizers within the past year

Public Utilities

*Monongahela Power Co.
*Iowa Electric Light & Power Co.
Utah Power & Light Co.
*Northern States Power Co.
*The Potomac Edison Co.
*Superior Water, Light & Power Co.
Central Ohio Light & Power Co.
*City of Owensboro, Ky.
City of Austin, Minn.
*Corn Belt Power Co-operative
*Public Service Co. of Colorado
Hartford Electric Light Co.

Industrial Plants

St. Croix Paper Co.
Hooker Electrochemical Co.
*Pittsburgh Plate Glass Co.
Celanese Corp. of America
United States Steel Co.
*Western Electric Co.
*Continental Can Co.
Monsanto Chemical Co.
Northern Paper Mills
Bell Aircraft Corp.
Syracuse University
Riegel Textile Corp.
Owens Corning Fiberglas Co.
*U.S. Finishing Co.
*Ciba States, Ltd.
*East Newark Realty
Lawless Brothers Paper Co.

These companies have never previously used Riley pulverizers.
The other companies have repeatedly ordered Riley pulverizers.

These contracts were engineered by the following consultants

Bechtel Corporation
Ebasco Services
Chas. T. Main, Inc.
Pioneer Service & Engineering Co.
Sargent & Lundy
Sanderson & Porter
Stone & Webster Engineering Corp.
Black & Veatch
United Engineers & Constructors
Stanley Engineering Co.
Kenneth R. Warrington
J. V. Edeskuty
Francisco & Jacobus
Douglas M. McBean
Robson & Woese, Inc.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

ADVERTISEMENT

WE MADE several attempts to write a conventional ad telling you about the new Line Post insulator. It just couldn't be done. There wasn't space to tell the story and the unsupported claims for this new insulator sounded too strong to be believed. What we really would like would be to sit down at your desk with a sample of the Line Post and talk it over with you for a few minutes. So, if we may invite ourselves in, let's pretend we are doing just that, using the photograph as a poor substitute for the insulator.

The Line Post is used wherever pin type insulators are used. It sets directly on the cross arm and is held in place by a center stud attached to the malleable iron base, and going through the cross arm like the stud of an ordinary pin. The conductor rests in the groove in the top and is tied in place in the usual way. Strength is the same as that of an ordinary insulator and pin.

66-KV. LAPP LINE POST

The insulator, as you see, consists of a porcelain post which is cemented into a base. There are two or three important points along this line. The porcelain is *one piece* and is hollow, the hole being closed at the top by a thick section of porcelain. The base grips the porcelain from the outside only. There is nothing within the insulator. The hole is closed at the lower end by a rubber plug slipped in place before cementing. The insulators come equipped with the stud and need no pin. The base is designed for use with flat arms. For crowned arms a roofing washer may be used.

Now that you know how it is used and something as to the way it is made you are probably wondering, "Just how will this insulator help me?" Well, in many ways, but suppose we tell you by going over the various characteristics that most people would like to have in their pin type insulators and see how the Line Post meets them.

RADIO INTERFERENCE—The Line Post *produces no interference* at the rated neutral voltage with a margin of safety ranging from 20% for the 66 Kv size to about 100% on the smaller ones. Loose or dirty tie wires do not lower this starting voltage very much, thanks to the new tie head. Briefly, the high voltage at which interference (and corona) starts is due to the small amount of charging current which this insulator requires. In other words, it has a very low capacitance—about one tenth that of an ordinary unit. The low capacitance results from the wide separation of the live terminals. Freedom *from interference comes from the design itself and does not depend on special treatments or coatings many of which have already proved to be temporary in nature.*

PUNCTURE is almost impossible in the Line Post because the puncture path is practically the same length as the flashover path. The insulator will invariably flash over. The duty on the porcelain is very mild and no thin section can be subjected to high electrical stress.

CRACKING—Insulator cracking results from the porcelain being loaded in tension. Some bursting force from within becomes so great that the porcelain can no longer bear it and the shell cracks. In the Line Post there is nothing within the insulator to exert such bursting forces. The hardware is cemented externally to the one piece porcelain with a large area, low intensity compression grip. Temperature changes between the base and porcelain can load the porcelain only in compression and it is very strong (50,000 to 75,000 pounds per sq. inch) in compression. *A most important point is that the safety of the Line Post comes from the design itself and does not rely on special treatments, test or assembly methods.*

BEHAVIOR UNDER POWER ARCOVER—Until we learn how to build lines which will never flash over the ability of the insulator to go back in service after power arcover will be important. The Line Post gets its leakage and flashover distance from many short, sturdy flanges rather than from broad, spreading shells. Tests and operating experience show that short petticoats of this type are much less subject to damage than are the large ones. If under most severe conditions one or two flanges are lost you can see that the flashover and leakage distances are lowered very little.

MECHANICAL ATTACK—The same qualities that make this insulator behave well under power arcover protect it from serious damage under mechanical attack. Tests show that stone and shot gun attacks at reasonable distances will do no damage. Rifle fire may rip off a petticoat. But—you haven't lost any appreciable percentage of the electrical characteristics and the insulator will surely stay in service. The leakage distance for a given rating is originally about 50% greater than that of a conventional insulator.

DIRT CONDITIONS—Six years experience with Lapp Fog Type insulators leaves no doubt as to the effectiveness of this type of leakage surface for such conditions.

APPLICATION—The Line Post may be used in either new or existing lines. *In all respects it is a general purpose insulator.* There are, however, certain locations in which it is especially appropriate to try out these units. Field experience indicates that insulator radio interference does not travel far along the line. It is an entirely practical matter to replace present units in a residental area with Line Posts, correcting local conditions and using the old insulators for maintenance. This can be done at very little cost over that necessary for regular operation. They may also be used to correct dirt conditions, in locations where mechanical breakage is severe or where lightning flashovers are common.

Based on over two years' completely successful operating experience under a wide range of climatic conditions, these insulators give promise of permanently correcting many of the defects of conventional insulators. We urge you to give these insulators a trial under the worst conditions on your system.

Ask for Bulletin No. 112 with full details and catalog information.

Thanks for your time and attention.

*See paper, "A New Porcelain Post Insulator" by G. W. Lapp

LAPP INSULATOR CO., INC., LEROY, N. Y.

THIS IS THE FIRST ADVERTISEMENT OF THE LAPP LINE POST TO APPEAR IN ELECTRICAL WORLD

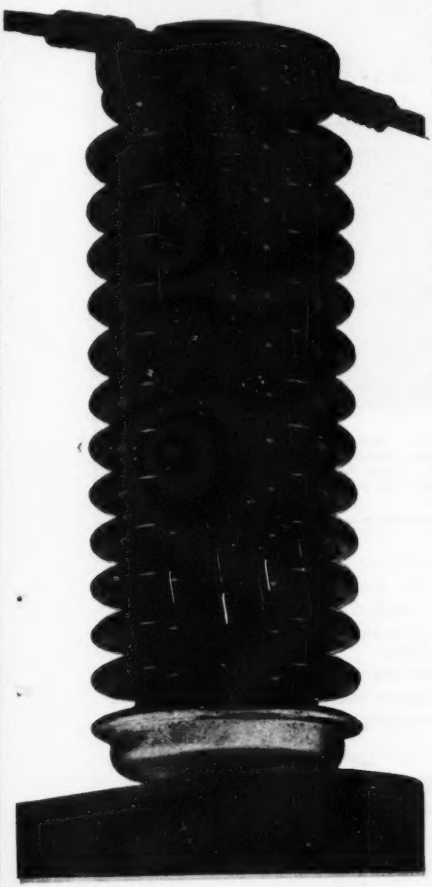
The Lapp LINE POST has a 20-YEAR service record

IT WAS "STRONG TALK" THEN . . .

. . . IT'S A PROVED RECORD TODAY!

If you've been a regular reader of Electrical World for 20 years, you probably saw the advertisement reprinted across the page. You probably agreed that such "unsupported claims for this new insulator sounded too strong to be believed."

But you may have read on, down to the punch-line "We urge you to give these insulators a trial under the worst conditions on your system." You might even have had a condition so bad that you were willing to give this untried and "radical" design a trial. If so, you can write the rest of this particular advertisement as well as we can. For a lot of fine engineers in a lot of fine companies *did* act on that suggestion. Never did an insulator have a more severe baptism-under-fire, nor a better chance to prove its merit. Wherever lightning was worst . . . wherever kids shot down insulators as fast as maintenance crews could put 'em up . . . wherever radio interference drowned out Amos 'N Andy . . . wherever scrub-brush-and-bucket brigades couldn't keep up with salt fog or industrial contamination . . . wherever insulation of transmission lines was next-to-impossible duty for conventional insulators, Lapp Line Posts got a trial.



What's the record of accomplishment? Why, most of the companies that made those early "trouble-spot" trials are the companies which have long since standardized on Lapp Line Posts.

There isn't anything we were saying about Lapp Line Posts twenty years ago that we haven't been saying since, and aren't saying today . . . *except* that . . . *the unsupported claims of 1931 are accomplishment proved by the record in 1951.* And that, in hundreds upon hundreds of long-service installations, the record proves that *lines on Lapp Line Posts have fewer outages, require fewer insulator replacements and less maintenance than comparable lines on any other type of insulator.*

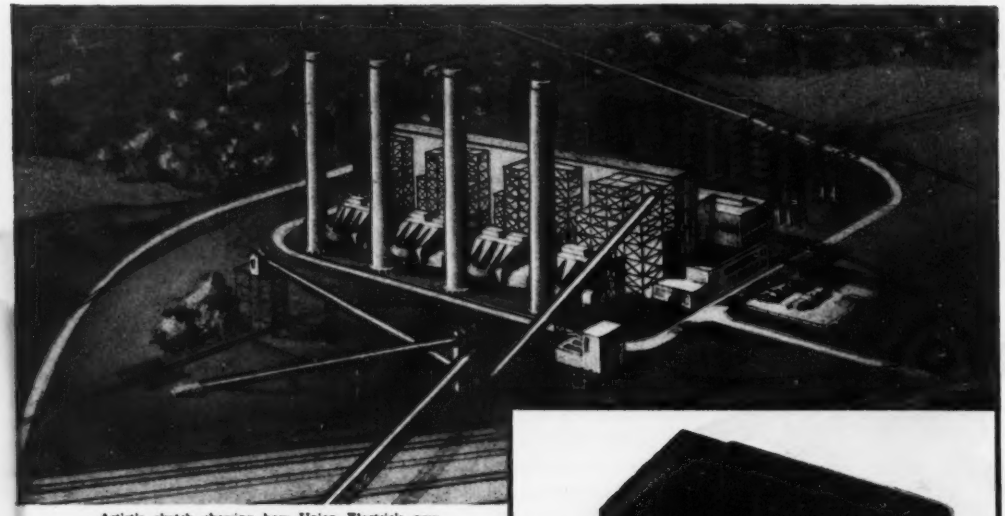
You, too, will have fewer service interruptions . . . you'll save on manpower . . . you'll reduce maintenance costs . . . when you write into your transmission line standards and specifications "*Lapp Line Posts.*"

Lapp

LAPP INSULATOR CO., INC., LE ROY, N.Y., U.S.A.

New Meramec Station of Union Electric Co. to install two 90,000 sq ft

I-R RECTANGULAR CONDENSERS



Artist's sketch showing how Union Electric's new Meramec Station will look when all four sections are completed. First section is already under construction, with equipment for the second section on order.

This giant Rectangular Surface Condenser serves a 150,000 kw turbine generator in a Mid-Western central station. The compactness of the I-R rectangular design made it possible to fit the cube-shaped space available.

This new ultra-modern steam plant, located near St. Louis, Mo., is designed to include all the latest developments in power generation. The first section, which is now under construction, will cost $26,000,000.

The turbine-generator unit for the first section has a nameplate rating of 110,000 kw and is designed for 1250 psi steam at 950° F. It will be served by a two-pass Ingersoll-Rand Rectangular Condenser containing 90,000 sq ft of condensing surface. High pressure steam will be supplied by a boiler producing 925,000 lb per hour primary and 850,000 lb per hour re-heat. Another I-R Rectangular Condenser—identical to the first—has already been ordered for the second section of this new plant.

Compact I-R Condensers, such as these two, save valuable space and head room because their rectangular design fits the rectangular space available under the turbine. Installation expense is also greatly reduced because even these huge 90,000 sq ft units are completely assembled at the factory. Then they are disassembled and shipped in large sections which are flanged for easy erection without field-fitting or strength-welding.

Your Ingersoll-Rand engineer will be glad to give you complete information on these modern surface condensers and other I-R equipment.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 637-4

COMPRESSORS • AIR TOOLS • ROCK DRILLS • TURBO-BLOWERS • CONDENSERS • CENTRIFUGAL PUMPS • DIESEL AND GAS ENGINES

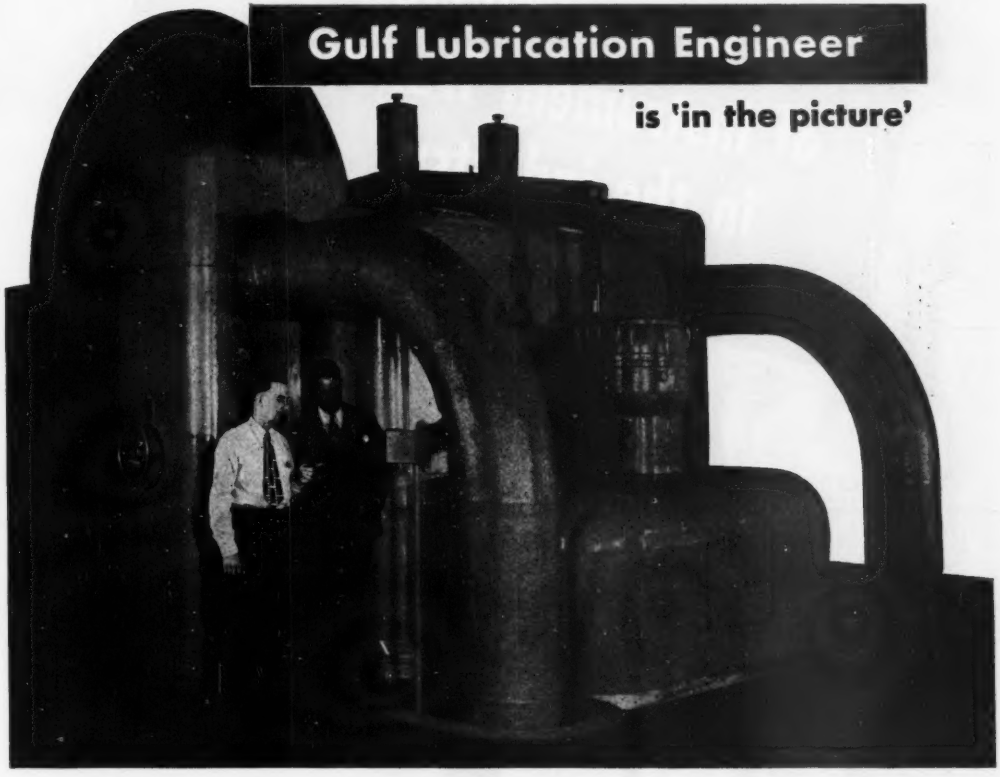
You get practical help

on lubrication and maintenance problems

when the

Gulf Lubrication Engineer

is 'in the picture'



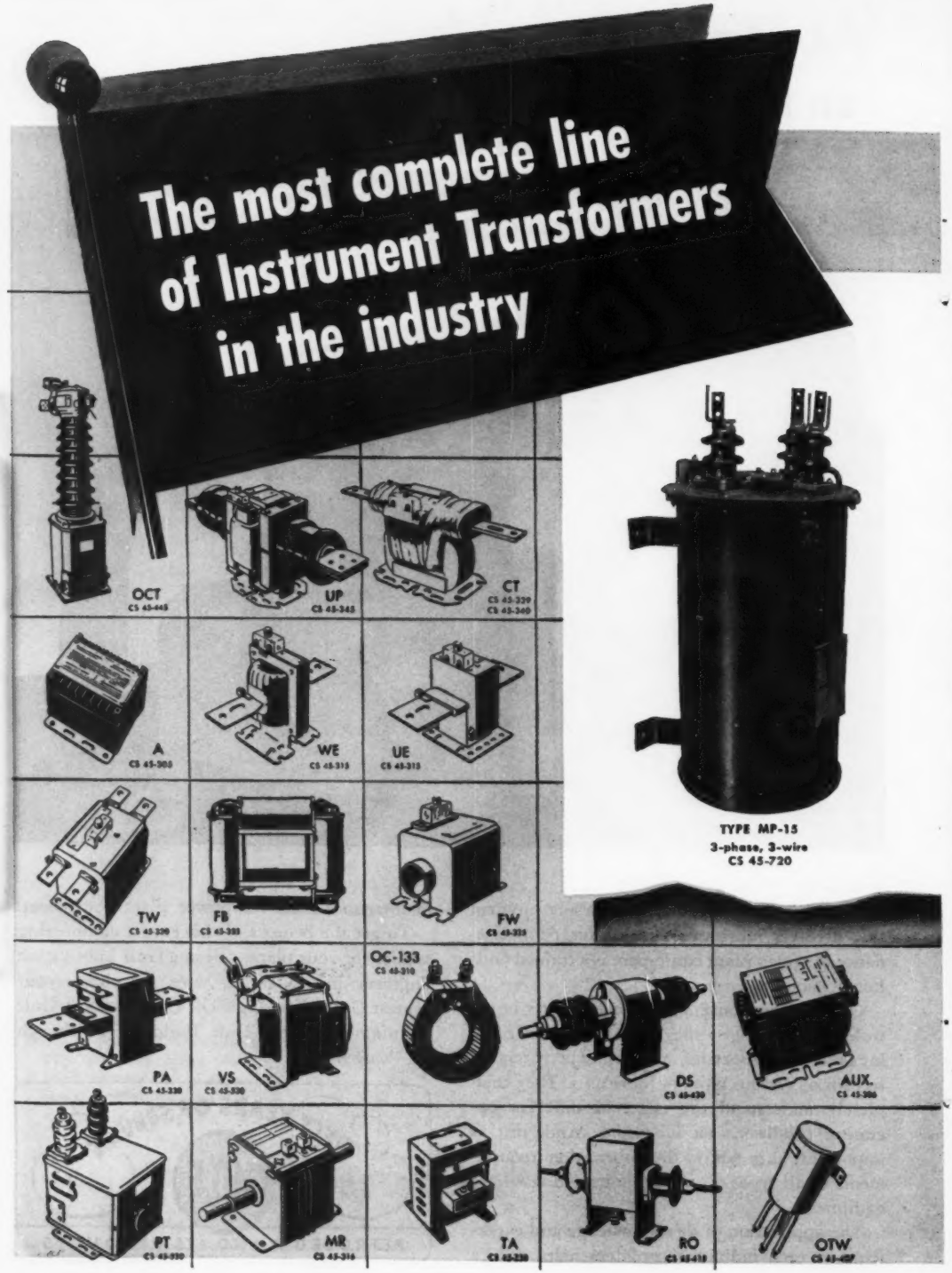
One of the best sources of help on any problem that involves lubricants, lubrication, or maintenance of power plant equipment is a trained Gulf Lubrication Engineer.

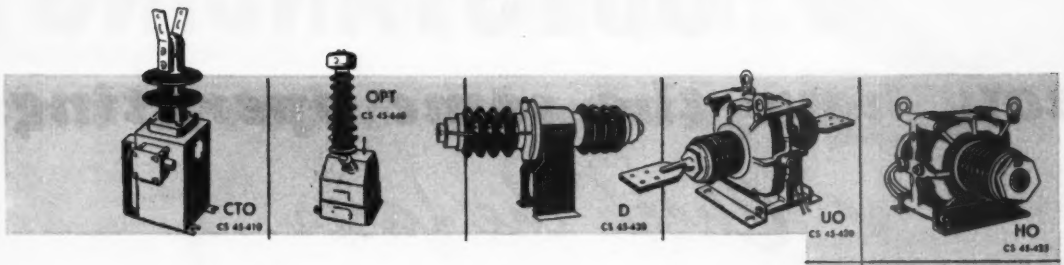
Gulf Lubrication Engineers are experts in petroleum technology—they are familiar with refining processes, properties, and the past performance records of various types of lubricants. They completely understand the effect of different operating conditions on lubricants. And, just as important, they know the lubrication requirements of all types of turbine units and auxiliary equipment.

The application of this knowledge and experience to each individual problem helps reduce maintenance costs for power plant equipment.

To get the benefits of this expert engineering service for your plant, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh 30, Pennsylvania.

FIFTY YEARS OF SERVICE
1901 GULF 1951
PETROLEUM AND ITS PRODUCTS


The most complete line
of Instrument Transformers
in the industry
OCT
CS 45-445
UP
CS 45-345
CT
CS 45-339
CS 45-340
A
CS 45-305
WE
CS 45-315
UE
CS 45-315
TW
CS 45-320
FB
CS 45-335
FW
CS 45-325
OC-133
CS 45-310
PA
CS 45-330
VS
CS 45-530
DS
CS 45-430
AUX.
CS 45-506
PT
CS 45-930
MR
CS 45-316
TA
CS 45-230
RO
CS 45-410
OTW
CS 45-407
TYPE MP-15
3-phase, 3-wire
CS 45-720



Versatile . . . for metering, relaying, control!

The Type MP combines current and potential transformers in one unit for single or three-phase systems, from 2.5 to 161 kv. Westinghouse Outdoor Metering Outfits, Type MP, are designed for highest accuracy metering, relaying and control device applications.

Because he handles the most complete line in the industry, your Westinghouse salesman has specific answers to all your instrument transformer problems. For further information on any of these transformers, ask him for a copy of the catalog section identified by the "CS" number under each transformer illustrated. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70605

YOU CAN BE SURE... IF IT'S

Westinghouse

INSTRUMENT TRANSFORMERS

2 OUTSTANDING

now have the same operating

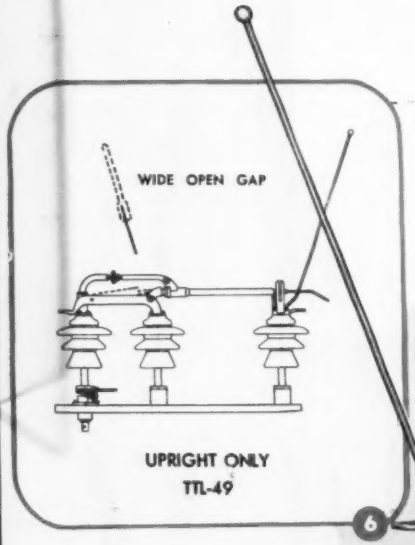
✔ Check the facts...

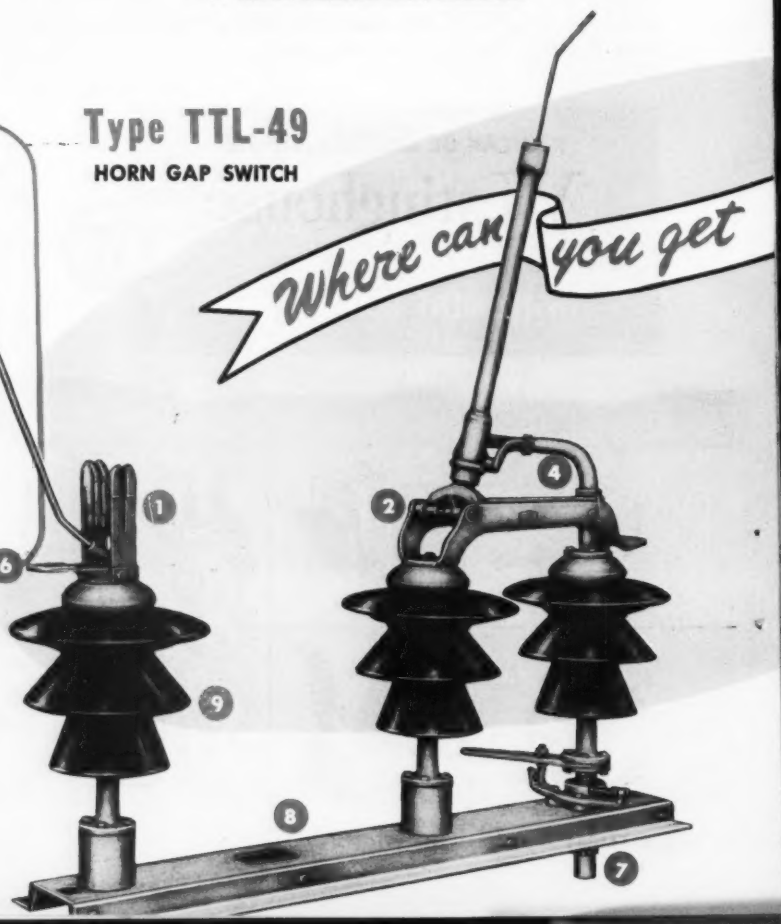
1. **Hi-Pressure Contacts. Hi-Thermal capacity silver to copper contacts, beryllium and copper jaw. Beryllium for strength and resiliency, and copper for high conductivity.**
2. **Hinge Contact - completely enclosed and weather sealed Hi-Pressure, Hi-Thermal capacity, silver to copper Hinge Contact. Continuous, constant electrical and mechanical contact. Eliminates second break contact with its multiplied problems.**
3. **Contact released by blade rotation before blade starts opening operation.**
4. **Continuous Blade Operation - contact release and blade lift both are accomplished through smooth, uninterrupted blade operation with rotating insulator.**
5. **All parts on live side of insulator are non-ferrous.**
6. **Terminals - both at same height from base. Clamping type with four half inch bolts at 1¾ inch centers. Universal, type UC clamps furnished.**
7. **Greaseless, anti-friction, all-weather bearing supplied with stainless steel ball bearings.**
8. **Rigid, galvanized steel channel base.**
9. **NEMA Standard B.I.L. insulators.**

Type TTL-49

HORN GAP SWITCH

Where can you get



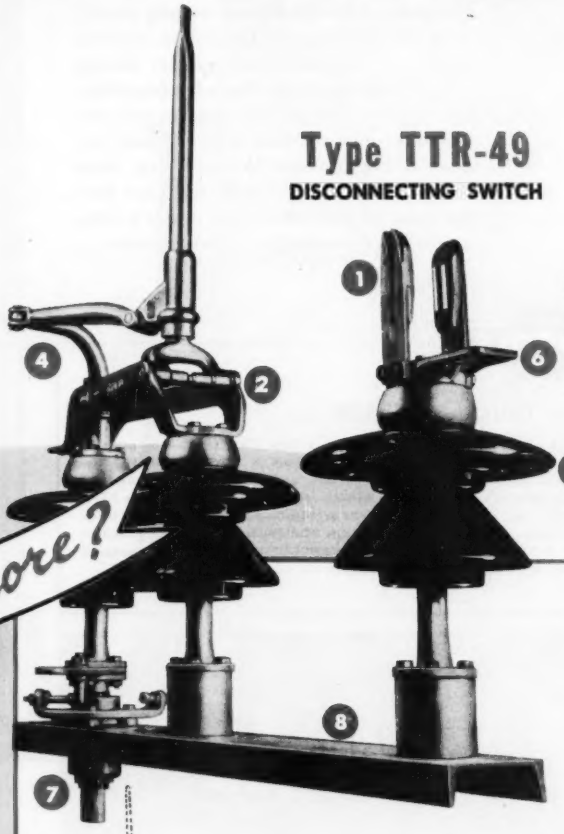


Wide gap, for many years an outstanding advantage in TTL switches, has been maintained in the TTL-49. Available for installing in upright position only. Up to 69 Kv.

R&IE SWITCHES

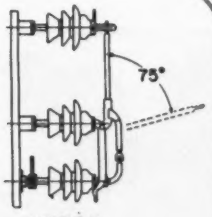
and service advantages

Type TTR-49
DISCONNECTING SWITCH

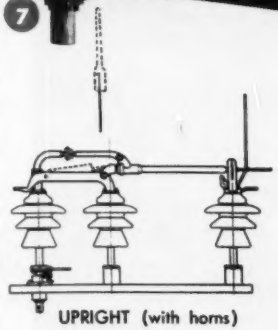


Type TTR-49 Disconnect can be mounted in upright, inverted or vertical positions - and upright only with horns. All voltages.

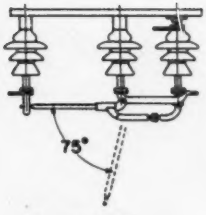
more?



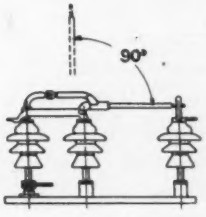
VERTICAL
TTR-49



UPRIGHT (with horns)
TTRA-49



INVERTED
TTR-49



UPRIGHT
TTR-49

RAILWAY and INDUSTRIAL ENGINEERING CO., Greensburg, Pa.
IN CANADA—EASTERN POWER DEVICES LIMITED, TORONTO
AN I-T-E SUBSIDIARY

The Check List

- CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- HORN GAP SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- DISTRIBUTION EQUIPMENT
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SWITCHING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

Rugged . . . tough and thrifty, too!

CHEVROLET

ADVANCE-DESIGN

TRUCKS

For trucks that are *right* on the job—*always* on the job—see these new Chevrolet trucks. They're able to carry the loads you handle, and able to *keep on* carrying them through tough job after tough job. They're economical and easy to handle, too . . . loaded with new features that pay off for you on *every* job. Features like the new self-energizing brakes for more *stopping* power. And like Chevrolet's Dual-Shoe parking brake . . . engineered for greater *holding* power. Here are trucks that offer important new comfort features. Ventipanes for controlled ventilation, and new cab seats for more riding comfort. In every way, these Chevrolet trucks are right for your job. See them at your Chevrolet dealer's now.

CHEVROLET DIVISION OF GENERAL MOTORS
DETROIT 2, MICHIGAN

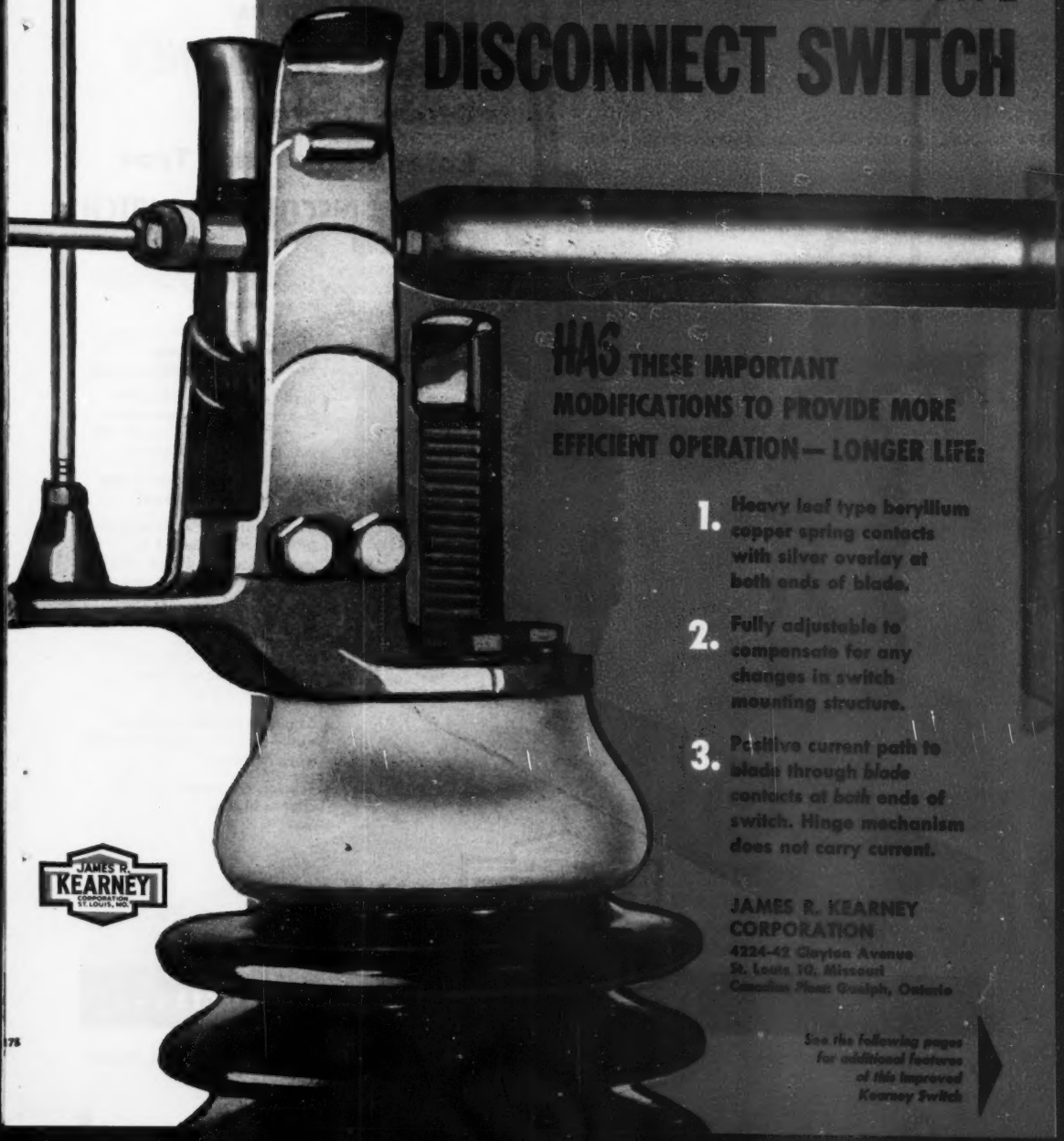
CHEVROLET

ADVANCE-DESIGN TRUCK FEATURES

TWO GREAT VALVE-IN-HEAD ENGINES—the 105-h.p. Loadmaster or the 92-h.p. Thriftmaster—to give you greater power per gallon, lower cost per load • POWER-JET CARBURETOR — for smooth, quick acceleration response • DIAPHRAGM SPRING CLUTCH—for easy-action engagement • SYNCHRO-MESH TRANSMISSIONS—for fast, smooth shifting • HYPOID REAR AXLES—for dependability and long life • NEW TORQUE-ACTION BRAKES—for light-duty models • PROVED DEPENDABLE DOUBLE-ARTICULATED BRAKES—for medium-duty models • NEW TWIN-ACTION REAR BRAKES—for heavy-duty models • NEW DUAL-SHOE PARKING BRAKE—for greater holding ability on heavy-duty models • NEW CAB SEATS—for complete riding comfort • NEW VENTIPANES—for improved cab ventilation • WIDE-BASE WHEELS—for increased tire mileage • BALL-TYPE STEERING—for easier handling • UNIT-DESIGN BODIES—for greater load protection • ADVANCE-DESIGN STYLING—for increased comfort and modern appearance.

The NEW KEARNEY *Group Operated*

ROTATING INSULATOR TYPE DISCONNECT SWITCH



HAS THESE IMPORTANT MODIFICATIONS TO PROVIDE MORE EFFICIENT OPERATION — LONGER LIFE:

1. Heavy leaf type beryllium copper spring contacts with silver overlay at both ends of blade.
2. Fully adjustable to compensate for any changes in switch mounting structure.
3. Positive current path to blade through blade contacts at both ends of switch. Hinge mechanism does not carry current.

JAMES R. KEARNEY CORPORATION
4224-42 Clayton Avenue
St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

See the following pages for additional features of this improved Kearney Switch

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

These Improvements

Check These Advanced Design Features of the NEW KEARNEY Group Operated Rotating Insulator Type DISCONNECT SWITCH

- √ Streamlined design with smooth edges throughout.
- √ Stop on base bearing easily adjusted to synchronize break on each phase.
- √ Blade operates in two Oilite bearings for all temperature operation. Bearings require no maintenance or lubrication.
- √ Blade lever adjustment sealed with noncorrosive grease.
- √ Stainless steel spring in neoprene jacket. Easily adjusted for desired counterbalance. (On switches rated 34.5KV and up.)
- √ Main hinge pin rotates in Oilite bearing.
- √ Arm rotates in completely weather-protected Oilite bearing in frame.
- √ Single arcing horn operates easily under ice. Easily replaced when necessary.
- √ Tubular, electrolytic bus bar copper blade.

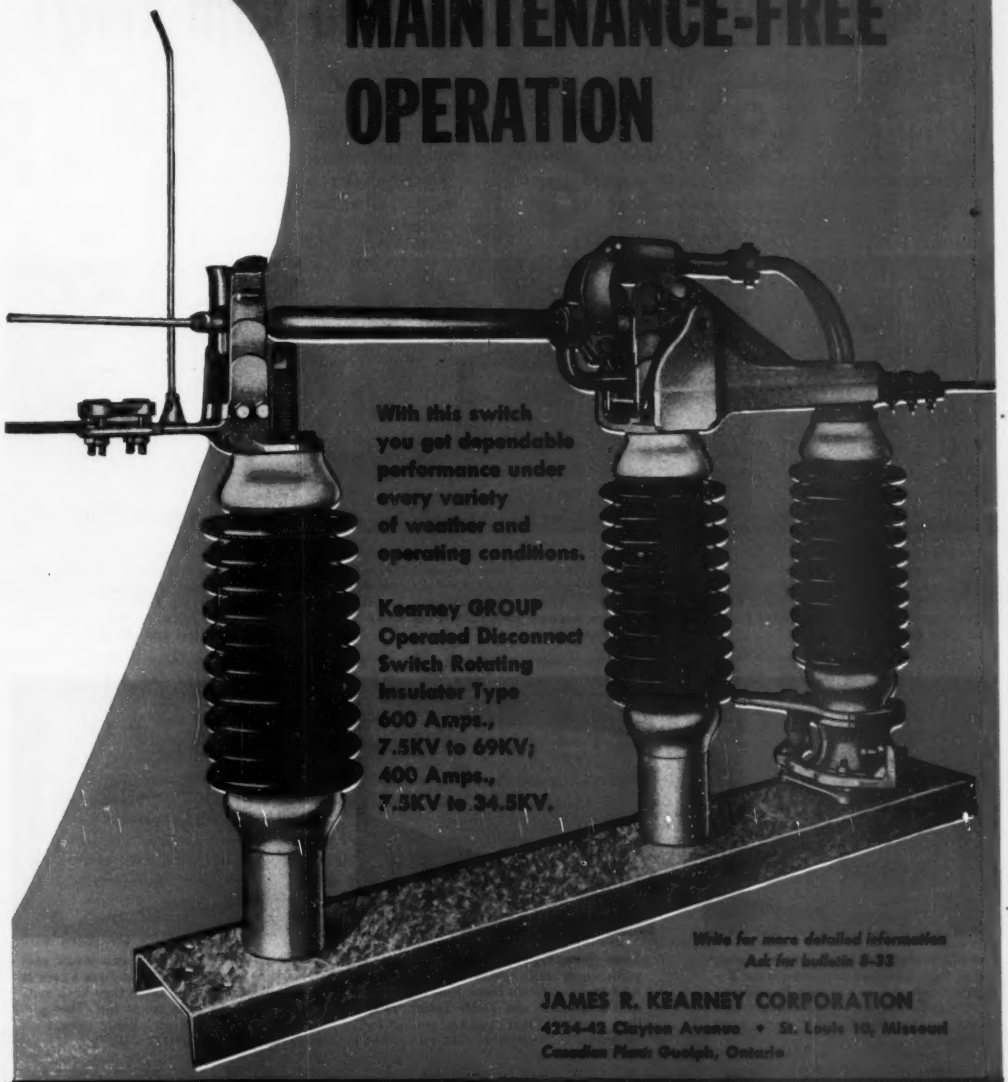
JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

179

Specify KEARNEY Products . . .

Guarantee

COOLER, MAINTENANCE-FREE OPERATION



With this switch you get dependable performance under every variety of weather and operating conditions.

Kearney GROUP Operated Disconnect Switch Rotating Insulator Type
600 Amps., 7.5KV to 69KV;
400 Amps., 7.5KV to 34.5KV.

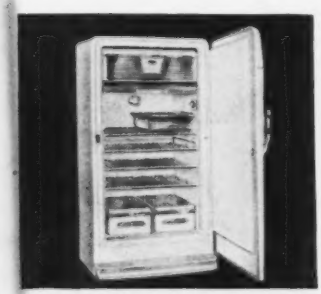
Write for more detailed information
Ask for bulletin S-33

JAMES R. KEARNEY CORPORATION
4224-42 Clayton Avenue • St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

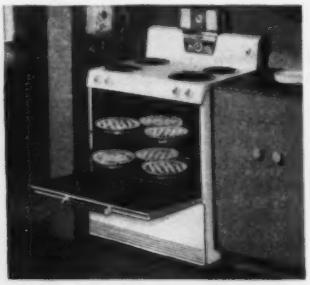
Better Construction – *SAFER* Maintenance

Electricity has revolutionized farm living!

Sixteen short years ago, only one farm family in seven had electricity. At the end of this year, electricity will be available to 95% of the nation's farms —and the output of goods per man-hour on the farm has soared to 156% of the 1935-39 average. Frigidaire salutes this amazing achievement *in bringing the electrical way of life to more people.* For electricity refrigerates, cooks, washes clothes and dishes, heats water, irons, cleans, pumps water, milks cows, grinds feed, lights the house and farmyard — does hundreds of farm chores, and is a servant in the home . . . all at the flip of a switch!

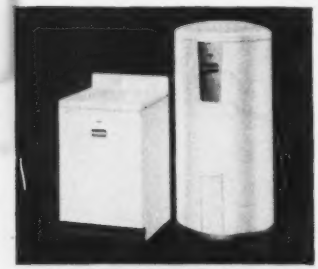


Refrigerators are no longer a luxury, but a real necessity for farm families. They not only save time and effort, but provide the family with necessities—help make extra money on cream, eggs, milk, poultry, butter and other produce.

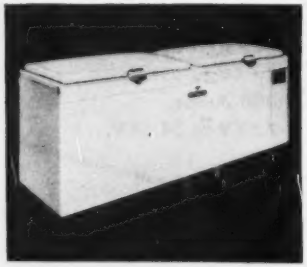


Electric Ranges equipped with automatic controls, free rural home makers for other tasks instead of keeping them chained to hot stoves. And they're economical for all families, because electricity is the cheapest servant known.

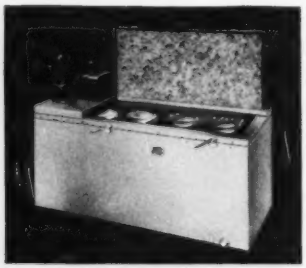
Automatic Washers take most of the work out of washing clothes. Save time too, because many clothes can be ironed without line drying. Even *with* drying, they save time and labor, because damp-dried clothes weigh less and dry faster.



Electric Water Heaters provide running hot water where and when you want it—automatically, and at low cost. In addition to the home, an electric water heater is a wise investment for the dairy man—saves time and work.



Food Freezers save trips to town, store garden surplus, help add variety to meals. And freezing foods costs less, takes less time and labor, and yields better results than canning. Farm meat and poultry can be frozen and eaten over many months.

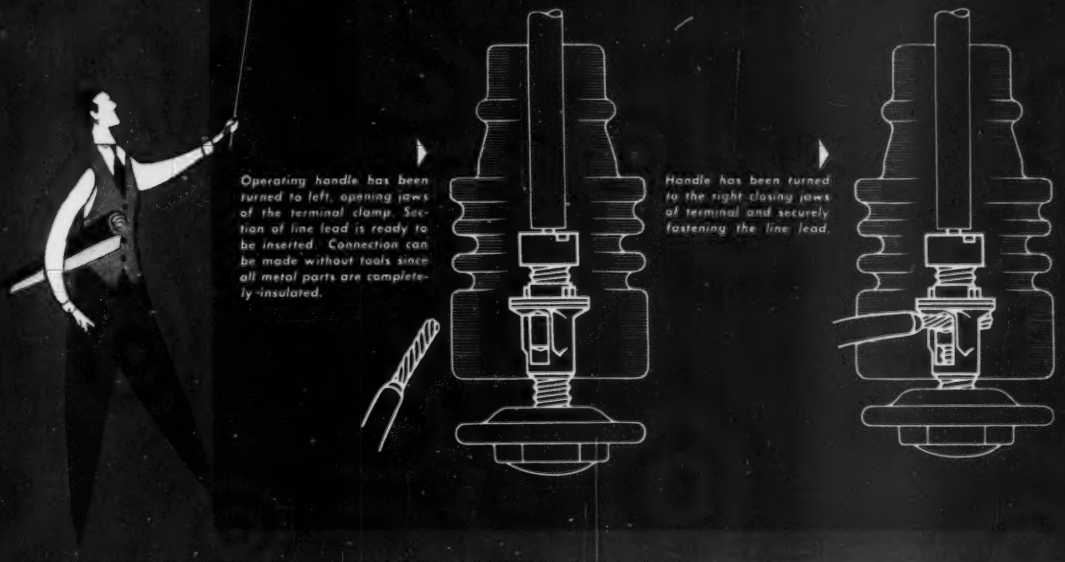


Electric Milk Coolers can mean cash savings of hundreds of dollars a year to the dairy farmer, because they keep milk sweet and bacteria count low. They prevent waste, and bring a better price for a better grade product.

Frigidaire **Appliances for the Farm Home**

IT'S A FACT:

KUHLMAN QUICK-GRIP... MOST COPIED TRANSFORMER BUSHING... BECAUSE IT SIMPLIFIES LINE CONNECTION JOB!



Operating handle has been turned to left, opening jaws of the terminal clamp. Section of line lead is ready to be inserted. Connection can be made without tools since all metal parts are completely insulated.

Handle has been turned to the right closing jaws of terminal and securely fastening the line lead.

Here's the bushing terminal that is rapidly becoming the choice of transformer buyers all over the country . . . the Kuhlman "Quick-Grip!" Specified by utility engineers everywhere, many other transformer manufacturers have copied its design features.

Ask any lineman what he thinks of the Kuhlman "Quick-Grip." Let him tell you how it eases and speeds his job of making line connections by eliminating use of tools. All he does is insert the lead into the hole in the side of the bushing and secure the connection by simply turning the handle on the end of the terminal. That's all there is to it! The clamp accommodates full range of wire sizes prescribed by EEI-NEMA Standards; mounting hardware is inside the tank protected from corrosive effect of the atmosphere.

The "Quick-Grip" is favored too, because of its safety features. Heavy insulating knob prevents accidental contact with live parts. Lead enters through side of bushing eliminating necessity of gripping over the lead when making connections as in the case of a rotating chuck type terminal. Since there is only one entry hole for the lead, its sharp point cannot protrude on the opposite side of the bushing to be a hazard to the lineman.

Write today for full details on the Kuhlman "Quick-Grip" bushing . . . it is available on all Kuhlman transformers 5KV and below where sidewall high voltage bushings are standard.

Kuhlman ELECTRIC COMPANY, BAY CITY, MICHIGAN

EXPORT REPRESENTATIVES: [illegible]

K E

Note: behind this arc . . . some 80,000 hours!

. . . when this job-site welder strikes his first arc on your new power piping system, his welding rod has behind it some 80,000 hours of experience . . . specific experience in welding chrome-moly hi-pressure, hi-temperature piping for utility power installations. That's Kellogg's background for the highly specialized power installations of today. Add to this Kellogg's experience in heat treatment and non-destructive testing of thousands of these alloy welds. This total specialized experience is why more and more of the critical piping systems are specified "main steam and reheat piping by M. W. Kellogg".

NEWS FOR OPERATORS IN WESTERN CANADA!

Canadian Kellogg Company has established complete shop facilities for the fabrication of all types of piping at **EDMONTON** in Alberta Province. Inquire directly or through any Kellogg office.

To make temperatures, pressures and chemicals use

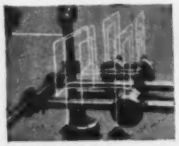
M. W. KELLOGG

piping and process equipment

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

KELLOGG 50th ANNIVERSARY 1901 - 1951



Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Pressure Vessels
Vacuum Vessels
Fractionating Columns
Drums and Shells
Heat Exchangers
Process Piping
Bends and Headers
Giant One-Piece Bends
Forged and Welded Fittings
Radial Brick Chimneys
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The M. W. Kellogg Company. (A Subsidiary of Pullman Incorporated) — Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris.

LOCKE

presents masterpieces of
insulator engineering

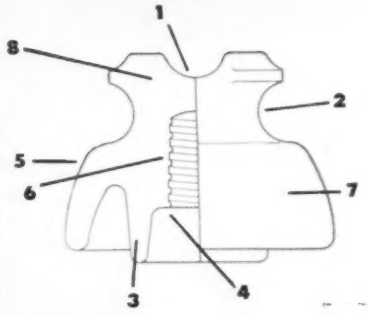
ECONOMICAL . . . because they're TROUBLE-FREE!

LOCKE
LOW VOLTAGE
PIN TYPE
INSULATORS
typified by
No. 9995

Help yourself lick rising costs. Install Locke Low Voltage Pin Types . . . first developed by Fred M. Locke in 1893. The millions now in active service . . . some installed as early as 1894 . . . give ample proof of their economical, trouble-free performance. Always specify them.

Presenting A MASTERPIECE OF INSULATOR ENGINEERING

The LOCKE *low voltage* Pin Type Insulator



LOCKE DESIGN brings you ALL these advantages

1. Smooth, deep, bell-mouthed top wire groove accommodates conductors as large as 4/0 ACSR with armor rods.

2. Deep, well-formed side wire groove provides positive support for conductors placed here for angles. Will take conductors as large as 4/0 ACSR with armor rods.

3. Deep, open corrugations develop full leakage distance and prevent bridging during rain.

4. The inner petticoat flares out quickly from pin. This assures freedom from arcing from tip of inner skirt to pin. Thus, insulator leakage distance is fully effective.

5. Uniformly smooth glazed surface means easy natural cleaning by wind and rain. It also helps insulator maintain original excellent electrical characteristics.

6. Accurately formed, glazed pin hole threads assure tight fit on pin; minimize possibility of radio interference.

7. Compression glaze . . . a Locke development . . . combined with finest grade Locke wet process porcelain assures high resistance to damage from thermal shock and mechanical impact. This also means Locke insulators can be handled faster in construction without danger of chipping or breaking.

8. On NP types the head, conductor grooves and pinhole are glazed with Locke semi-conducting Metaglaze for corona and radio noise suppression.

9. Locke Pin Type insulators conform fully to N.E.M.A. Standards.

YOU ARE EQUALLY SURE of getting a masterpiece of design when you specify other products in the complete line of Locke insulators and suspension hardware. Each pays off in superior performance on transmission and distribution lines, generating stations, sub-station and electrical apparatus. Locke Department, General Electric Company, Baltimore, Maryland.

LOCKE

LOW VOLTAGE PIN TYPE INSULATORS

HIGH VOLTAGE PIN TYPE INSULATORS

SUSPENSION INSULATORS

SWITCH & BUS INSULATORS

SPOOL INSULATORS

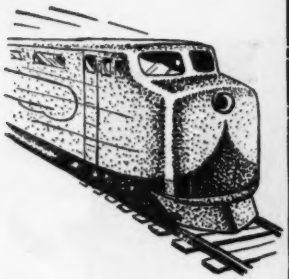
GUY INSULATORS

LIQUID-FILLED BUSHINGS

SUSPENSION & STRAIN CLAMPS

SUSPENSION HARDWARE

ENTRANCE BUSHINGS



REACHING OUT 20 MILES TO LEAD A TRAIN

Railroad signal and communication engineers require dependability above all other things in the equipment which they buy. When it comes to signal cables, which are the vital connecting links between control machines and signals, they have a serious problem. If the cables are installed in the air they are subject to cinders, sparks, heat, sunlight, sleet and rain. If they are installed underground, the cables must be able to withstand long-time exposure to water, soil acids and alkalies, vibration from passing trains, and the cutting effect of sharp cinders. This is brutal punishment. So how to get trains through safely and on time — not once, but every day in the year?

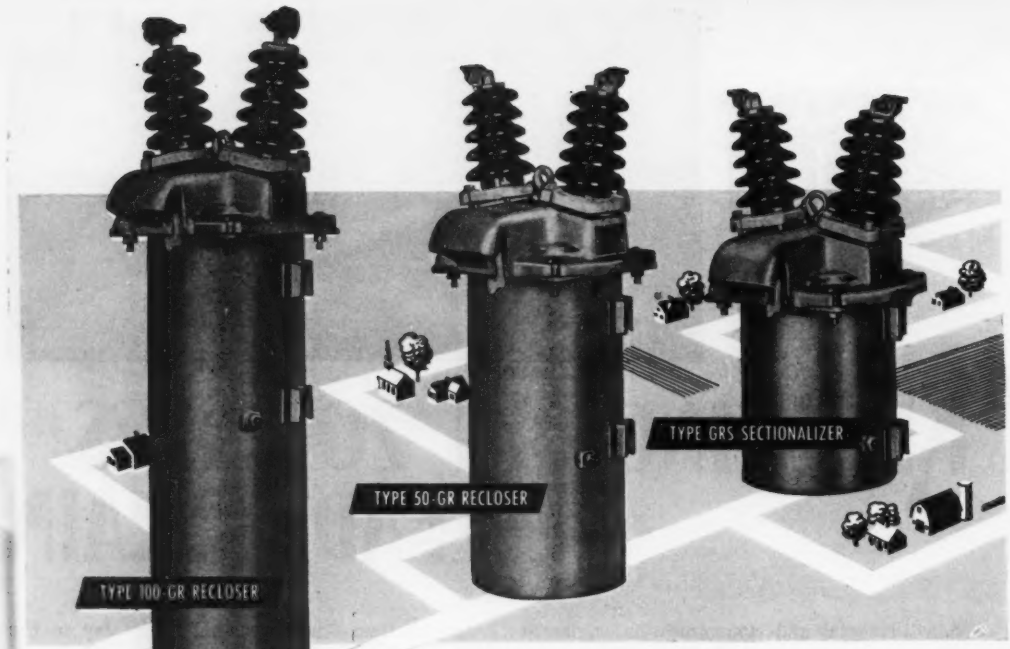
Fortunately, long before the railroads started to use CTC (Centralized Traffic Control) Simplex had developed an insulation that had excellent properties for signal and communication work and was dependably water resistant. That solved the moisture problem. The use of especially compounded neoprene as a jacketing material solved the problem of how to combat sparks, heat, sunlight, rain, etc. This is a typical example of how Simplex Research helps to provide just the right cable for the job.

Simplex Research gave you the first heavy duty, rubber-jacketed portable cord or cable; the first low water absorption insulation; the first rubber-jacketed underground cable. Besides these notable "Firsts" Simplex Research has provided a great many developments which have enriched the art of cable design.

SIMPLEX-ANHYDREX IS A PRODUCT OF SIMPLEX RESEARCH

SIMPLEX-ANHYDREX

SIMPLEX WIRE & CABLE CO., 79 SIDNEY ST., CAMBRIDGE 39, MASS



YOU NEED ALL 3

...for long-range distribution economy!

Calculate your probable fuse replacement costs over the next fifteen years—the period in which forecasts say loads will triple. We'll guess your answer suggests need for a less costly protective system. Ideally, it would be a system which eliminated fuse replacement costs... which stayed in perfect co-ordination *permanently*... which simplified the job of system sectionalizing on rural and suburban lines.

The units pictured above are components of a system which *does fulfill these requirements!* It's a completely mechanical system which employs Type 100-GR reclosers or reclosing breakers at the substation, and Type 50-GR reclosers co-ordinated with sectionalizers on the line. For forward thinking system planners it represents a *sure* way to gain this important objective:

THE HIGHEST DEGREE OF SERVICE CONTINUITY AT THE LOWEST LONG-TERM COST!

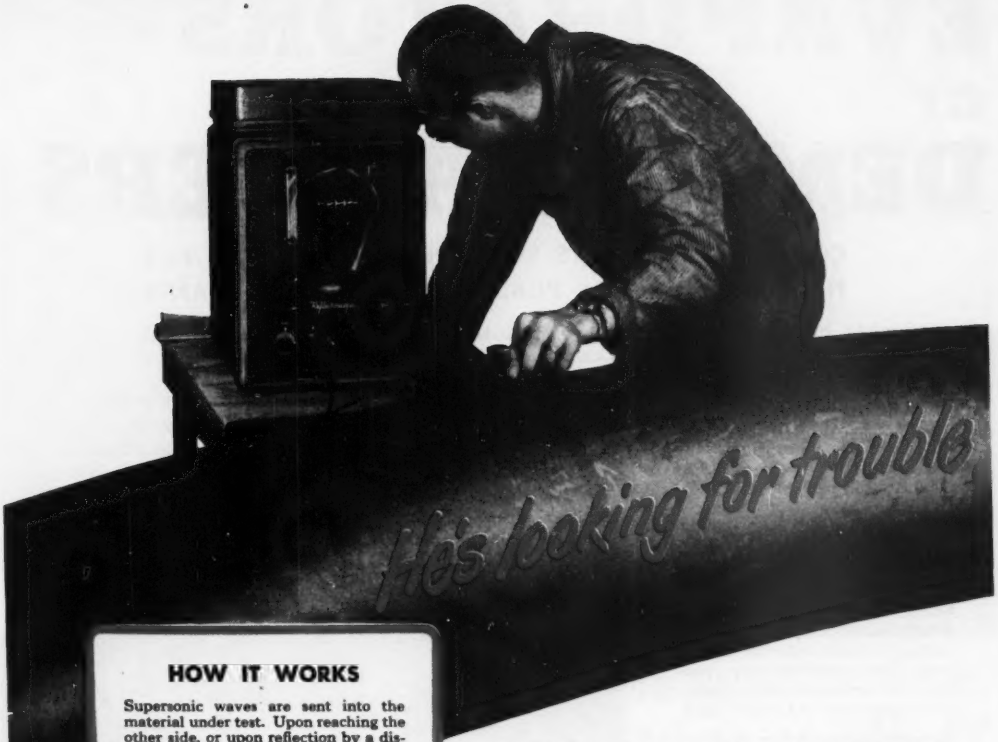
The mechanical protective system is just one of those analyzed in Booklet B-4700, which covers advantages, limitations and cost considerations of all types of protective schemes for rural and suburban lines. For your copy of this practical guide to better protection planning, write: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-60739

YOU CAN BE SURE... IF IT'S

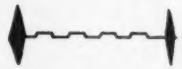
Westinghouse

DISTRIBUTION APPARATUS

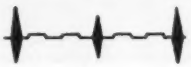


HOW IT WORKS

Supersonic waves are sent into the material under test. Upon reaching the other side, or upon reflection by a discontinuity, the waves return to their source and are then converted into a high-frequency potential. This potential is amplified by electronic circuits and projected upon the screen of a cathode-ray tube where they may be seen and examined.



Pulse pattern, showing the initial pattern at the extreme left and the reflection from the opposite side at the extreme right. The sweep line indicates no defects.



A typical indication of a defect is illustrated here. By means of calibration, it is now possible to determine both the exact position of the flaw, as well as its size.

Today, Supersonic testing is available on specification for inspecting Grinnell prefabricated piping. By observing the pattern produced by the electron beam on the fluorescent screen, any defects in the base metal, welds, or variations in pipe thickness can be located and measured at a glance.

Grinnell's ultra modern electronic testing can be relied upon to detect hidden flaws in pipe materials, to check unerringly the quality of welds where it picks up types of flaws not revealed by X-ray and gamma ray inspection. In examining bends, this type of testing can measure the degree to which bent pipe thins on the outside and thickens on the inside of the bend, assuring full specified thickness in high temperature, high pressure work.

Non-destructive Supersonic testing is another in a constant succession of new techniques employed by Grinnell to provide prefabricated piping which is safe and dependable . . . which measures up in every way to *rigid* state, national, association and insurance code requirements. It is another reason, too, why it will pay you to think of Grinnell "Whenever Piping Is Involved".

GRINNELL

WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago
Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York
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EVAPORATORS or DEMINERALIZERS

COCHRANE PRESENTS SOME INTERESTING DATA FOR THE OPERATORS OF PUBLIC UTILITY BOILER PLANTS

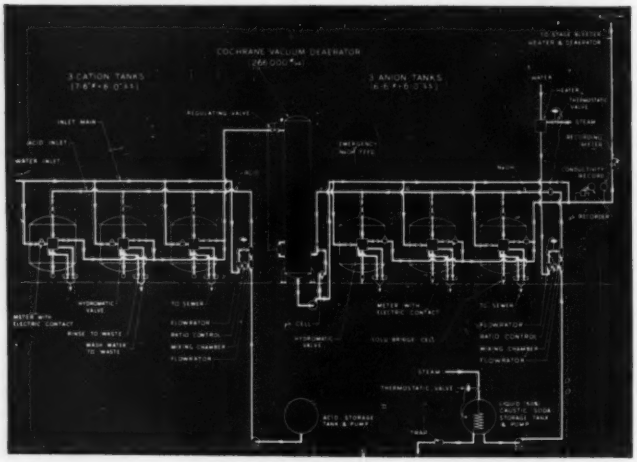
The adoption by a number of central power plants, of Demineralizers for treatment of boiler feedwater in place of evaporators, has aroused great interest on the part of utility operators everywhere. Cochrane Corporation has made a study of the subject and has some interesting facts which will bear examination.

ADVANTAGES OF DEMINERALIZING:

1. **Full makeup supply available continuously.** With evaporators the available capacity varies with the turbine load. Demineralizers can produce full desired makeup capacity irrespective of turbine load.
2. **Greater economy in overall station efficiency** with Demineralizers because no heat is used in producing demineralized water and no loss of power suffered by degradation of steam.
3. **Better quality makeup water.** Demineralized water has higher pH values than distilled water produced from an evaporator with CO_2 present in the vapor. Carry-over problem, common to evaporators, is eliminated. Total solids of actual demineralized water lower than usual actual distilled water.
4. **Lower maintenance costs.** Corrosion in vapor and distillate lines avoided by Demineralizing.
5. **Lower labor costs.** Demineralizers can be made automatic.
6. **Greater flexibility of heat balance.** Frequently the heat balance must be changed due to increasing steam demands on plant. Evaporators interfere with such drastic heat balance changes. Demineralizers permit greatest flexibility.

Write for these papers:

Experiences with Silica Removal Demineralizers.—Paper presented Midwest Power Conference, April, 1951. Evaporation vs. Demineralizing and Silica Removal. A discussion at Engineering Society of Western Penna., October, 1950.



COCHRANE CORPORATION • 3146 **N. 17th St.** • **Philadelphia 32, Pa.**

In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City • In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE

Everson Electric Co. counts on SILASTIC TAPE "...When insulation must stand up at 500° F"

For outstanding insulation characteristics and for lasting performance at high temperatures, the choice is Silastic* Tape at Everson Electric Company, Allentown, Pa., manufacturers of armature, field and stator coils for railway and heavy-duty industrial applications.

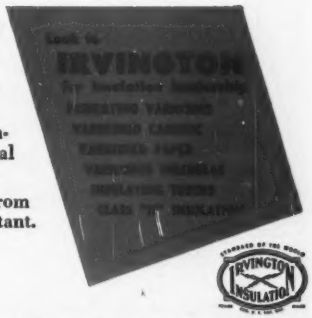
"The ability of Irvington's Silastic Tape to stand operating temperatures up to 500° F increases the life of our coils," says Everson, "and it saves space *too*."

Here are some *other* reasons why so many leading manufacturers turn to Silastic Tape:

The combination of Fiberglas cloth and Silastic rubber impregnation and coating gives high tensile strength and excellent chemical resistance, even at high temperatures.**

After vulcanizing, Silastic Tape forms a solid insulation mass, free from voids or air pockets . . . moisture-proof, extremely abrasion-resistant.

Worth looking into, isn't it? Ask for the full story today!



*® Dow Corning **® Owens Corning Fiberglas Corp.

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Gentlemen:

Please send me technical literature on Silastic Tape.

Name.....

Company.....

Street.....

City..... Zone..... State.....

How to the Efficiency Boiler-Room

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

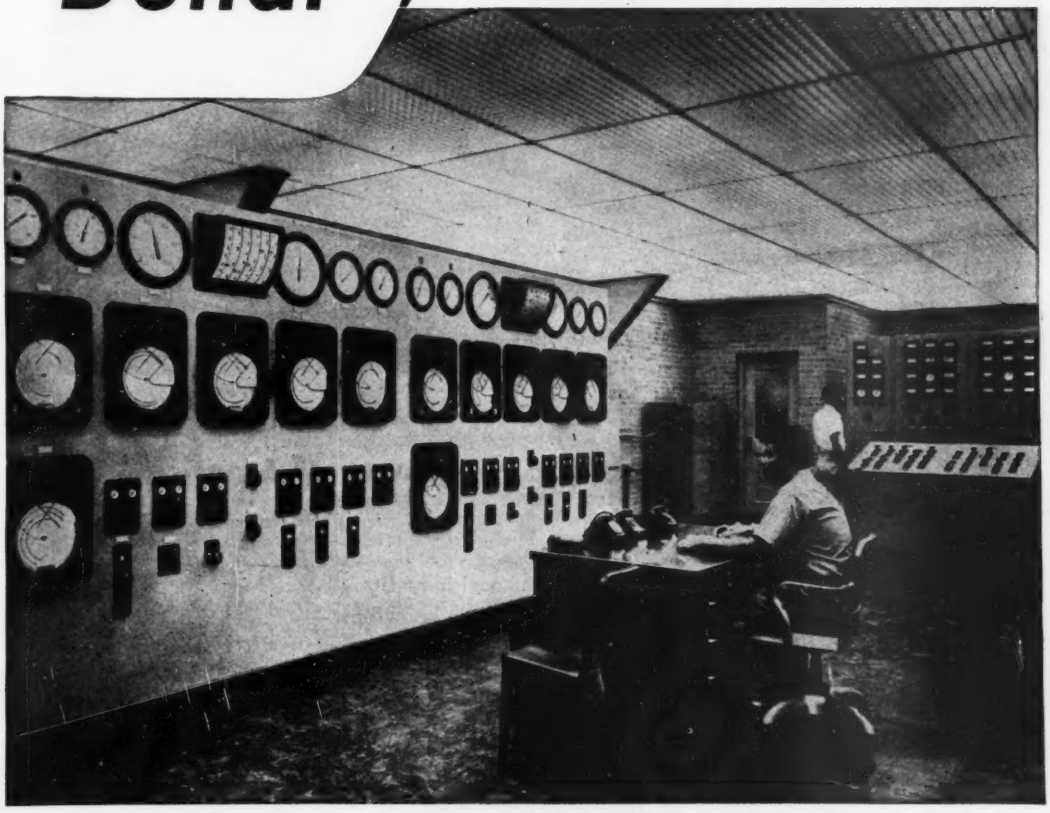
For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

111-1

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

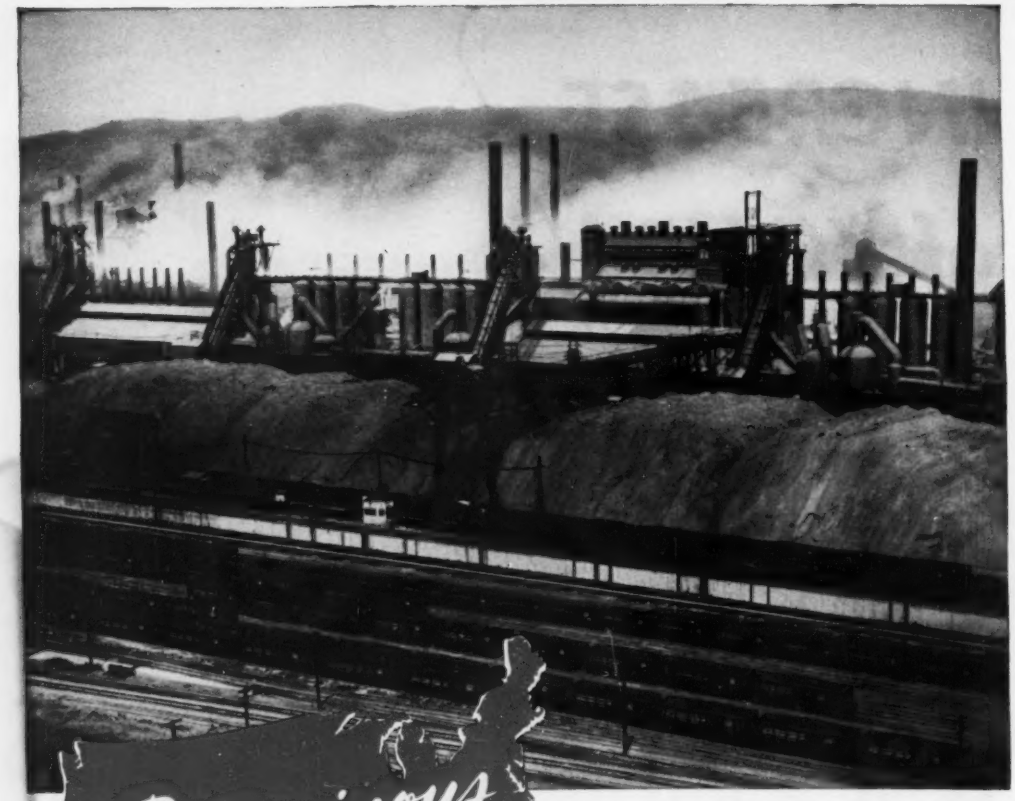
INCREASE of YOUR Dollar



These Bailey Boiler Controls for Combustion, Feed Water, and Steam Temperature insure efficient operation of two 450,000 lb per hr, 1000 psi, 900 F, gas and oil fired boilers.

BAILEY METER COMPANY

1060 IVANHOE ROAD • CLEVELAND 10, OHIO
BAILEY METER COMPANY, LIMITED • MONTREAL, CANADA



Bituminous is indispensable to the power of America

The bituminous coal industry
has the strength—the know-how—
to meet *any* challenge.

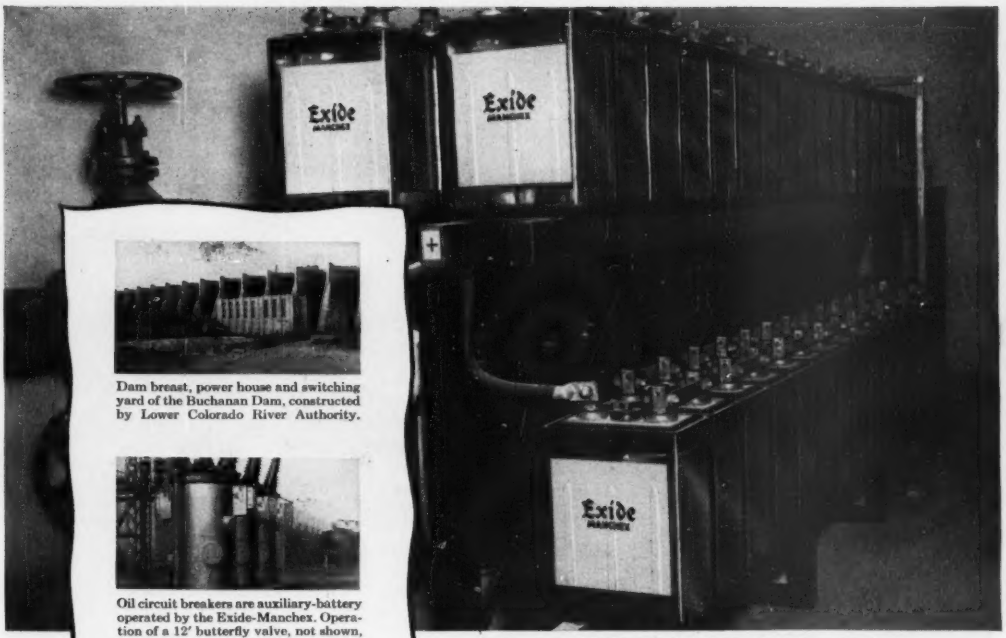
Only with indispensable bituminous
can the greatness of America be maintained.

For excellent bituminous coals
to meet your every need,
Ask our man!

BALTIMORE & OHIO RAILROAD

Constantly *doing things* **—better!**

LINKING 13 GREAT STATES WITH THE NATION
B&O



Dam breast, power house and switching yard of the Buchanan Dam, constructed by Lower Colorado River Authority.

Oil circuit breakers are auxiliary-battery operated by the Exide-Manchex. Operation of a 12′ butterfly valve, not shown, is a new application of emergency battery power.

Bank of 60—EME-13C Exide-Manchex Batteries at Buchanan Dam. Mounted back to back on two 2-step Exide Racks.

POWER for the heart of Texas

Exide-Manchex BATTERIES

A short distance above the capital city of the Lone Star State, a power station enlarged in 1949-50 is in operation. Buchanan Dam, a unit of the Lower Colorado River Authority, is one of the most modern and finest equipped stations in the country.

Among this fine equipment at Buchanan Dam is the Exide-Manchex, which provides dependable standby power for all storage battery operations. A logical choice, for in Exide-Manchex Batteries you get:

POSITIVE OPERATION. Dependable performance at ample voltage with no switching failures.

INSTANTANEOUS POWER, at high rates for switchgear operation, adequate reserve power for dependable performance of all other control circuits and also emergency lighting.

LOW OPERATING COST: Extremely low internal resistance.

LOW MAINTENANCE COSTS: Water required about twice a year. No change of chemical solution needed during life of battery.

LOW DEPRECIATION . . . due to sturdy, long-life construction.

GREATER CAPACITY in a given amount of space avoids overcrowding of equipment.

These are the features that help to make Exide-Manchex *your best battery buy* for all control and substation services.

• • •

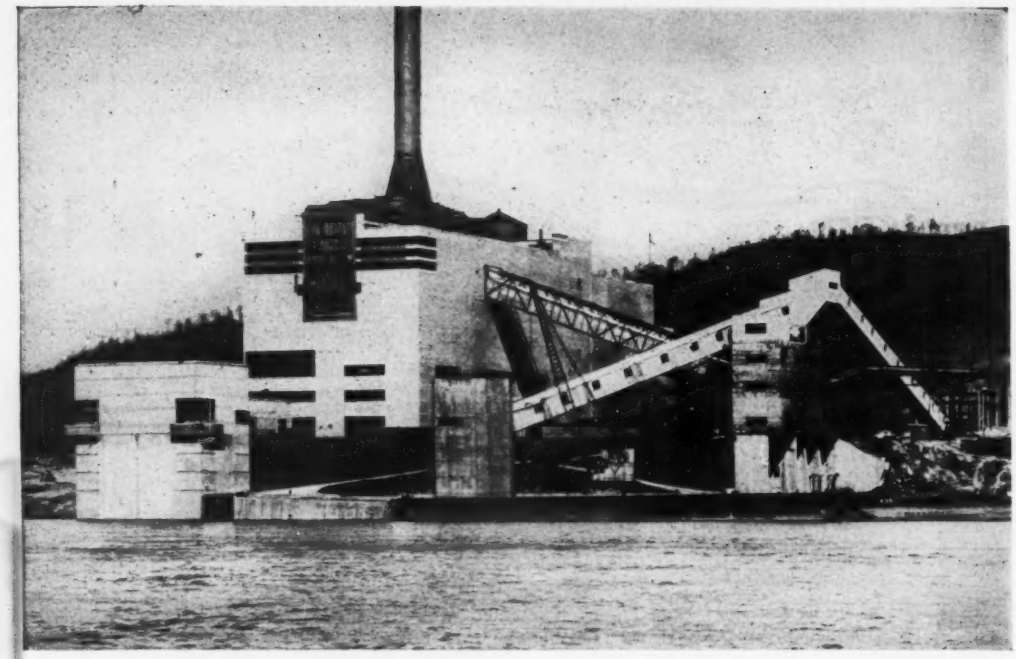
LEAD CALCIUM BATTERIES

Exide first produced Lead Calcium Batteries in 1935. Since that time we have progressively followed an extensive program of laboratory research and development along with a study of Exide Lead Calcium Batteries in actual service.

Much has been learned during those 16 years. Though the time is too short to specifically predict length of battery life, definite conclusions have been reached regarding proper application. We will be glad to inform you where these cells can satisfactorily serve.

THE ELECTRIC STORAGE BATTERY CO.
Philadelphia 2
Exide Batteries of Canada, Limited, Toronto
"Exide" and "Manchex" *Reg. Trade-marks U. S. Pat. Off.*

1888 . . . DEPENDABLE BATTERIES FOR 63 YEARS . . . 1951



Unique Circulating Water System Installed in This Power Plant

The R. E. Burger steam-electric plant of Ohio Edison Company is located on the Ohio River well above flood stage—which may reach as much as 60 feet above extreme low water. Water is supplied to the condensers by a patented circulating water system pioneered jointly by Worthington and the consulting engineer, Mr. George W. Saathoff.

All major equipment except circulating pumps, which are designed to operate completely submerged if necessary, are located above flood stage.

The new installation of a Worthington 70,000 sq ft two-pass condenser and auxiliaries, serving a 90,000 kw turbine-generator, is the third Worthington unit in this station. Two 46,000 sq ft condensers were previously installed.

For advice on any new installation or information on a wide range of power plant equipment, consult Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

HOW IT WORKS

Two full-capacity circulating pumps are used in series.* The primary pump, submerged below extreme low water, is a Worthington motor-driven BIFLO. Its high starting head characteristic is able to deliver enough water for starting purposes. A booster pump—a single-suction volute Worthington MIXFLO, mounted directly upon an hydraulic turbine—starts when there is enough water in the control well. The two pumps then operate automatically in series at full capacity.

Advantage is taken of maximum siphon effect from the condenser drop leg which enters the sealing or control well. From this well, all circulating water is passed through the hydraulic turbine. Thus the static head from sealing well to river level is utilized—75-80% being recovered—in reducing the work of the primary pump, with saving in overall pumping power.

The booster pump functions until rising water renders the turbine ineffective. Then the primary BIFLO works alone, producing full capacity under reduced head.

*In the new unit, there are two half-capacity primary pumps, permitting operation of only one in the winter when low water temperatures prevail.

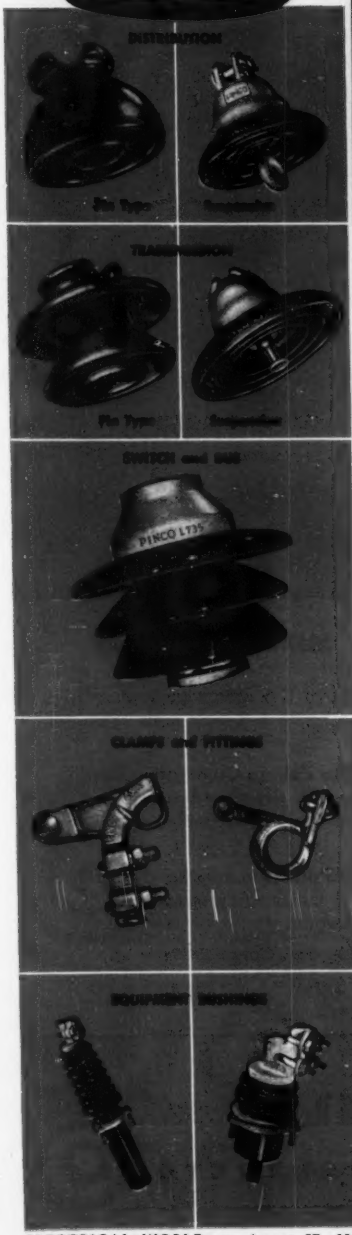
Z.1.1

WORTHINGTON

WORLD'S BROADEST LINE OF STEAM POWER PLANT AUXILIARIES

Feed Water Heaters	Boiler Feed Pumps	Steam Turbines
Steam-Jet Ejectors	Water Treating Equipment	Surface Condensers

PINCO INSULATORS



Installation of Pinco Universal Insulators on West Penn Power Company System.
"Those Pinco L1612 "Universal" Units Sure Make My Job Easier"...

Competitive Tests . . . Service Records Prove Pinco L 1612 "Universal" Insulators Perform Better, Longer . . . Cost Less to Service!

We're mighty proud of the results of the laboratory tests which proved the superiority of the Pinco L 1612. But we were not entirely surprised by the outcome, because service records over a period of *twenty years* of continuous operation back up these findings . . . records which prove that thousands of these Pinco L 1612 Units have been meeting their job requirements 100% in areas where excessive insulator contamination is an operational hazard. Certainly such a record of *trouble-free* performance proves that they're "right" where it counts . . . "right on the job!"

So when you have a tough job for insulators calling for L 1612 characteristics . . . put up Pinco *to be sure!*

IN COMPETITIVE "FOG OPERATION" TESTS
by a Western Power Company, Pinco "Universal" Insulator No. L 1612 proved its superiority by rating:

FIRST on "Fog arc over".
FIRST on sustained voltage "in fog" producing *no* arc over.
FIRST on sustained voltage "in direct spray" producing *no* arc over.
FIRST on both self-cleaning and manual cleaning characteristics.
SECOND on "sluice arc over".
EXCELLENT on radio interference characteristics.

Pinco L1612 & L1925 Features

1. Leakage distance of 17 inches.
2. Outside petticoats, shielded above by bell; below by hood.
3. Long, tapered hood is self-cleaning; acts as spatter-baffle to clean petticoats.
4. In strings, interior of hood is shielded by unit below—protected against contamination thus reducing manual cleaning requirements to a minimum.

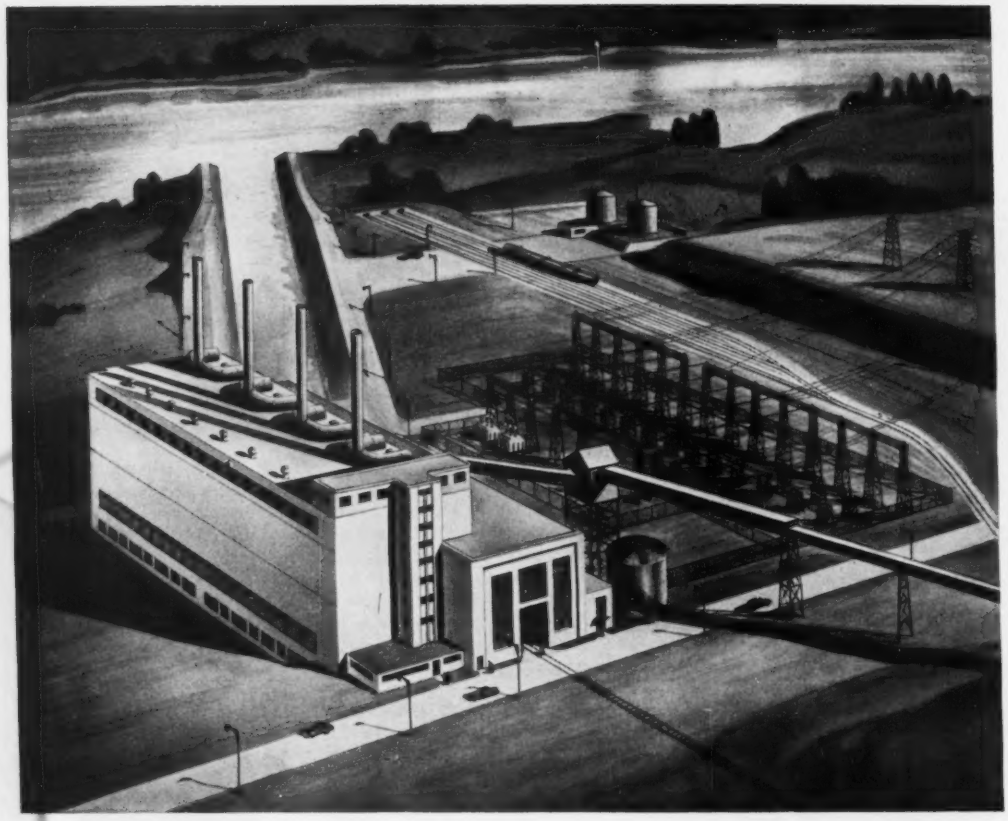
See Page 70, Pinco Catalog No. 49 for complete electrical and mechanical characteristics.

The Porcelain Insulator Corporation
761 Main St., Lima, N. Y.

Sales Agents: JOSLYN MFG. & SUPPLY CO.
Offices in Principal Cities

PINCO INSULATORS

Suspension Insulators . . . Switch and Bus Insulators . . . Distribution Clamps . . . Distribution Pin Types and Guy Strains . . . Transmission Line Fittings . . . Tree Insulators . . . Transformer and Circuit Breaker Bushings . . . One Piece and Multi-part High Voltage Pin Types . . . Suspension and Strain Clamps . . . Indoor Bus Support Porcelain . . . Lightning Arrester Porcelain.



POWER FOR MORE THAN A MILLION HOMES

The power produced in this great 200,000 KW steam generating power plant is enough to supply several million people with light and power.

To India where this has taken place, The Kuljian Corporation has sent men, materials, equipment and supplies to construct and operate this power station which was previously engineered and designed at our headquarters in Philadelphia.

Kuljian engineering and construction skill and resources have been applied to a wide range of utility and industrial projects under varying conditions in many parts of the world.

This seasoned experience in Engineering and Construction is also available to you.

WASHINGTON, D.C.
CALCUTTA, INDIA
ROME, ITALY
CARACAS, VENEZUELA
MEXICO CITY, MEXICO

The Kuljian *Corporation*

ENGINEERS • CONSTRUCTORS

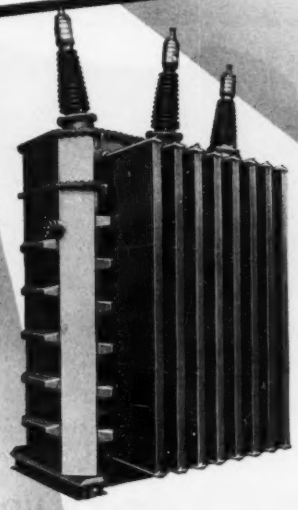
1200 NORTH BROAD STREET, PHILADELPHIA 21, PA.

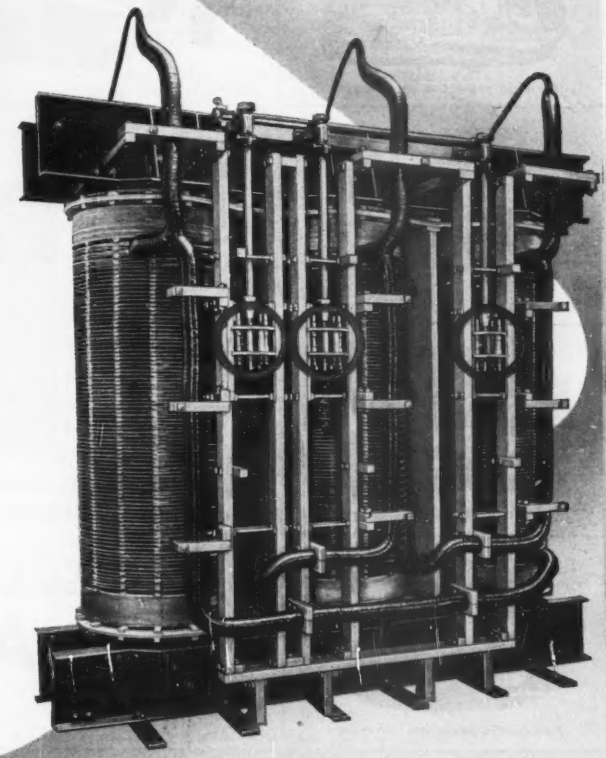
Wagner
TRANSFORMERS
... the choice of leaders in industry

WAGNER POWER TRANSFORMERS

QUALITY... ALL THE WAY THROUGH

Wagner Power Transformers have a reputation for quality —inside and out—established through sixty years of service to the power industry and proved by service records from the field, dating back to the early 1900's. They are liberally designed and are built with painstaking care to enable them to give years of uninterrupted service. Use of highest quality materials and rigid inspection and tests have made Wagner Power Transformers "the choice of leaders in industry."





Wagner Power Transformer Elements are particularly outstanding because of their inherent strength and stability and because of their compact design and careful construction. They have sufficient capacity to not only carry their normal load but to be able to handle an overload when the emergency arises. That's why Wagner Transformers have established records for continuous service and long life in all types of industrial plants and transmission lines.

Bulletin TU-181 tells the complete story . . . you should have a copy. Consult the nearest Wagner branch for advice on your next transformer installation.

Snap acting rotary type tap changers, designed to permit changing the voltage ratio quickly and effectively, are located near the taps and are connected for gang operation from a single operating handle outside the tank.

Wagner
Electric Corporation
1891 1951

TU-4

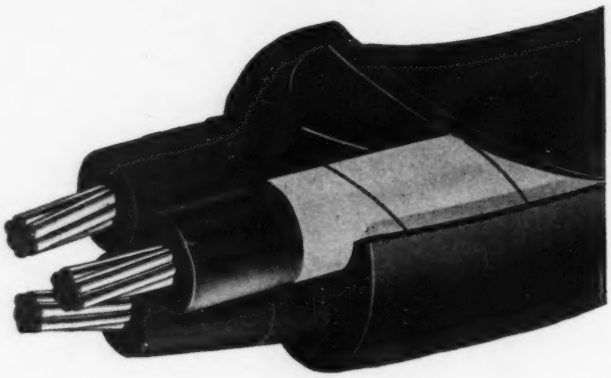
WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

DURASHEATH

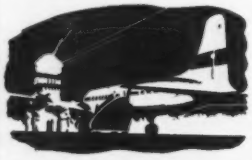
...the all-purpose cable



For city power and light systems

For rural power and light systems

For railroad signal systems



For airports,† mines, camps

For industrial power and light systems

good for almost any service up to **5,000** volts

DURASHEATH* stubbornly resists electrolysis, corrosion, temperature extremes, cutting, abrasion, impact, flame, oil, grease, moisture and most soil acids and alkalies. Can be run overhead, in ducts, or buried underground—or all three in one continuous run. Flexible, easy to handle and install. For further information, consult your nearest Anaconda Sales Office or Distributor. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York. 51388

†When ordered to CAA Specification L-824 *Trademark

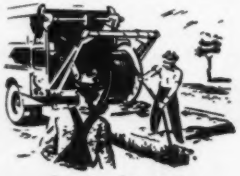
the right cable for the job

ANACONDA®

WIRE AND CABLE

String it overhead

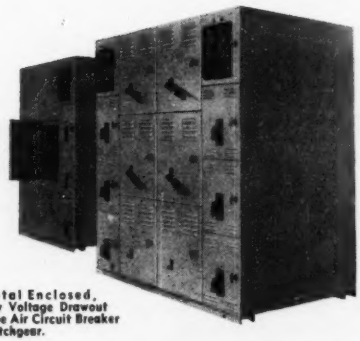
Pull it through ducts



Bury it underground

Our Complete Line
Contains the Answer to Your Electrical Equipment Needs

ROLLER-SMITH SWITCHGEAR



Metal Enclosed, Low Voltage Drawout Type Air Circuit Breaker Switchgear.

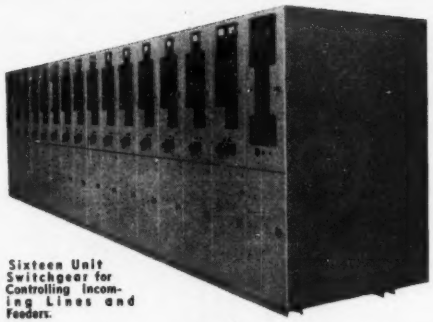
Includes the Following Types:

1. Low-voltage, metal-enclosed drawout or rigid air circuit breaker switchgear for outdoor and indoor service. Capacities to 5000 amperes at 600 volts ac and 5000 amps. at 250 dc. Drawout has telescoping rails for removing breaker.

2. Moderate duty, vertical lift indoor metal-clad, 400 to 1200 amps. 5000 volts, 25,000 and 50,000 KVA interrupting capacity.

3. Drawout metal-clad, 600 to 1200 amps., 5000 to 15,000 volts, 100,000 to 250,000 KVA interrupting capacity.

Also cubicles, benchboards, switchhouses, dead front distribution switchboard, unit substations.

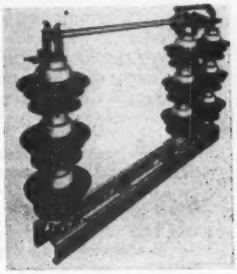


Sixteen Unit Switchgear for Controlling Incoming Lines and Feeders.

ELPECO SWITCHING EQUIPMENT

Duo-Roll High Pressure Switches Air Break Disconnecting

A complete line o switches with two hig' pressure contacts an permanent factory ad justment. Ratings fror 7.5 KV to 161 KV; 400 Amperes to 4,000 Amperes.



Horn Gap and Disconnecting types; upright, underhung or vertical mounted.

ELPECO FACTORY ASSEMBLED METAL-CLAD BUS RUN

Designed as a unit to fit the job—A type to fit every need—Segregated phase, non segregated phase, isolated phase insulated bus.

INVESTIGATE THESE ADVANTAGES:

Electrically Tested — Assures correct electrical characteristics.
Mechanically Tested—Assures strength and ability to stand short circuit stresses.

Saves Installation Cost—Eliminates incorrect fits, improper lengths, etc. Requires less time in field assembly.

To get the latest and most advanced Bus Run design, submit your specifications and let us make a recommendation.

ROLLER SMITH Established 1908

ROLLER-SMITH CORPORATION

ELPECO Established 1910

BETHLEHEM, PENNSYLVANIA

Low Voltage Air Circuit Breakers • Power Circuit Breakers • Power Switching Equipment • Bus Supports And Fittings • Low Voltage Drawout Type Switchgear • Metal Clad Switchgear • Generator Leads And Station Bus Runs • Outdoor Sub Stations • Unit Sub Stations • Instruments • Watthour Meters • Relays • Rotary Switches • Precision Balances

ALLIS-CHALMERS SWITCHGEAR

Helps Pratt & Flying Conditions

Unique Distribution System with Allis-Chalmers Switchgear and Control Board Protects and Controls Equipment in New Willgoos Jet Research Laboratory

IF YOU COULD STEP behind the walls of Pratt & Whitney's huge windowless jet laboratory — largest of its kind in the world — you'd see equipment designed to simulate flying conditions at 45,000 feet . . . ram blowers, exhausters, motors. Protecting valuable electrical equipment is Allis-Chalmers 500 mva metal-clad switchgear. An Allis-Chalmers duplex board remotely controls the equipment.

Allis-Chalmers engineers assisted materially in developing the unique scheme for control of the 24,000 hp dynamometer. Four shipboard type generators supply power to the dynamometer at frequencies which can be varied between 15 and 93.3 cps. Each generator can be connected to a common motor bus through the air blast circuit breakers. The synchronous motor of the dynamometer is connected to the bus through disconnecting and reversing switches.

To utilize generator capacity when the dynamometer is not in use, a constant frequency bus has been provided in the switchgear lineup. Additional switchgear units connect each generator to this bus for utilizing the generating capacity at 60 cycles.

Does your plant rely on standard Allis-Chalmers metal-clad switchgear for dependable equipment protection? If not, it will pay you to investigate.

Allis-Chalmers switchgear is completely assembled, ready to operate when delivered and installed. Standard units can be added as your load expands.

Allis-Chalmers switchgear is all steel enclosed, completely insulated and safety engineered. Furnished with air blast, *Ruptair* or oil circuit breakers.

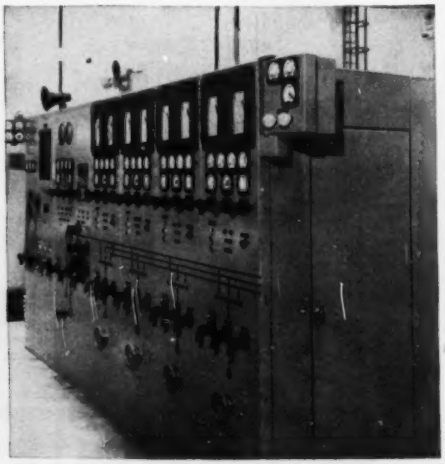
For more information on Allis-Chalmers switchgear contact your local Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

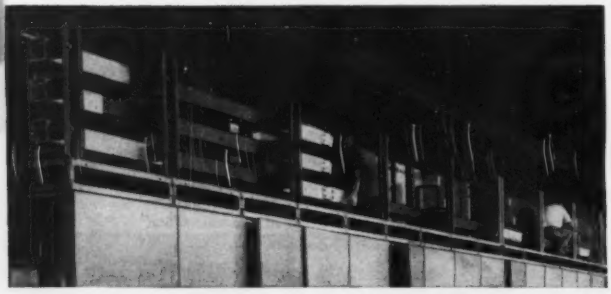
A-3306

The duplex tunnel-type metal enclosed control board (right) remotely controls the motor, the generators and other electrical equipment. Positive interlocking, instrumentation and recording assures the operator of accurate control of circuit switching.

This 4000 ampere 93.3 cycle metal-enclosed bus duct (below) connects the dynamometer to the disconnect and reversing switches. Its special design keeps reactance to a minimum.

Ruptair is an Allis-Chalmers trademark.



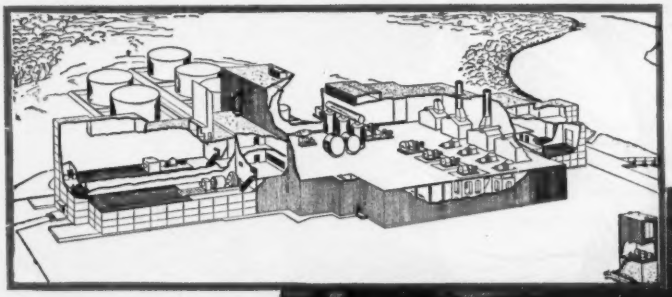


ALLIS-CHALMERS

A-C ALLIS-CHALMERS

First in the U. S. with Metal-Clad Switchgear

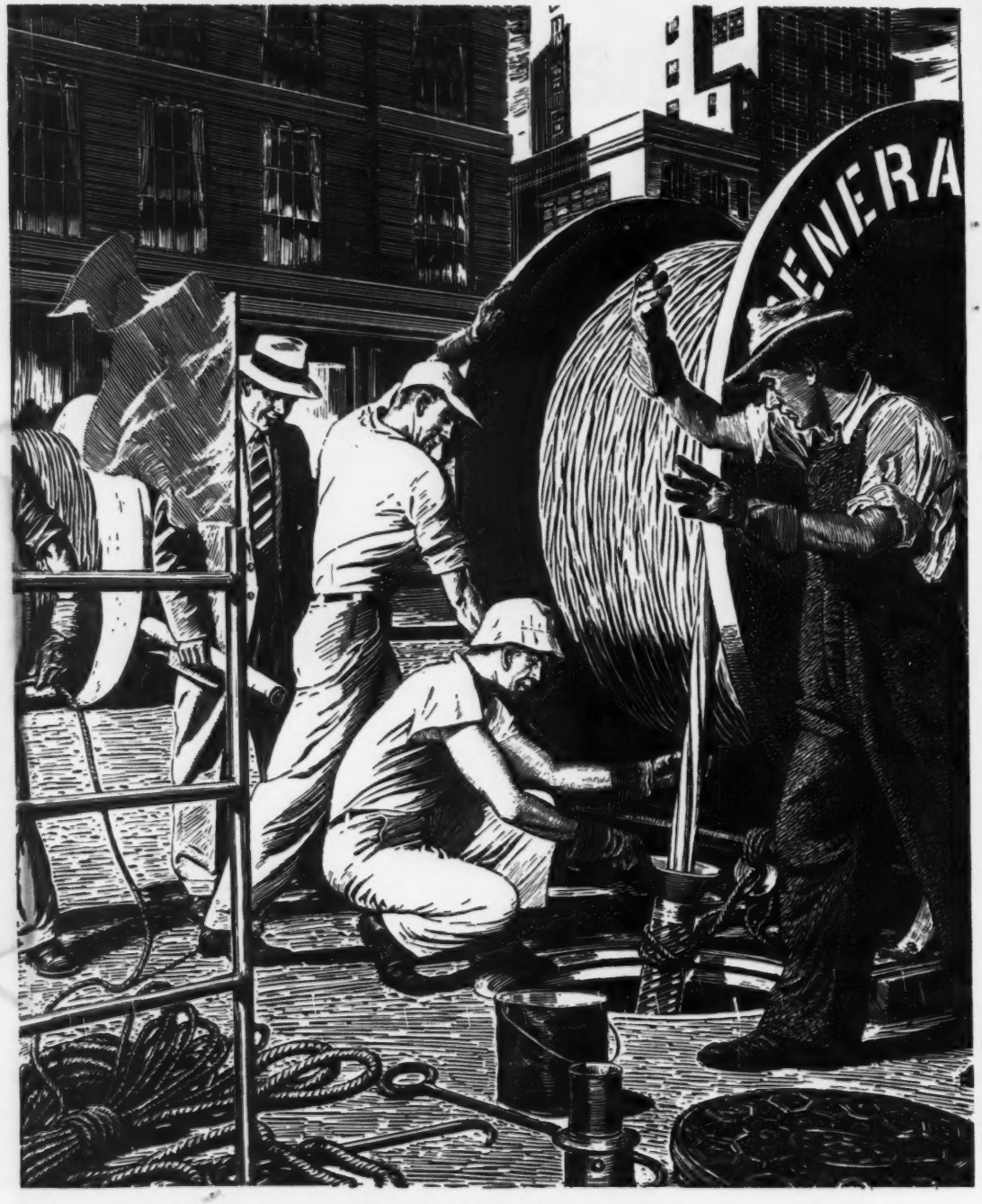
Whitney Simulate at 45,000 Feet



Allis-Chalmers switchgear with 500 mva air blast circuit breakers is used for control and dynamic braking of the 24,000 hp synchronous motor and for protection of generating equipment. Air blast circuit breakers are consistent performers under varying operating conditions. Both the operating mechanism and arc interrupting devices are air operated.

Willgoos laboratory (above) testing ground of aircraft engines of the future, is the largest privately owned building of its kind. Turbine engine burner components are tested in cells to the extreme right. Air speeds up to 550 mph and air temperatures down to −70° F are duplicated in the laboratory.

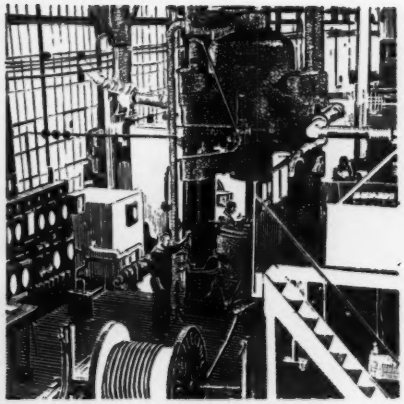
Driving power for turbine-compressor test cell comes from this Allis-Chalmers cradle-mounted dynamometer (right) using a 24,000 hp, 3000 volt, 3 phase, AK synchronous motor and torque measuring equipment. Dynamometer mounting permits measurements of gear output torque within an accuracy of one-half of one percent.



ON THE JOB, helping to plan expanded distribution, G-E specialists keep up to date on today's power needs. Information from the men in the field helps General Electric maintain completely modern manufacturing facilities.

WIRE AND CABLE FOR ELECTRIC UTILITIES

Up-to-the-minute methods for today's power needs



MODERN MANUFACTURING FACILITIES

AT GENERAL ELECTRIC, designers know they'll get what they specify, because General Electric's complete manufacturing facilities and up-to-the-minute techniques can fulfill any type of cable specification.

INSULATION RESEARCH
DESIGN ENGINEERING
LABORATORY TESTING
FIELD SERVICE
INTEGRATED EXPERIENCE

By maintaining close contact with distribution problems like yours—by coordinating our design techniques with today's planning requirements—we at General Electric offer the power industry a complete cable line produced by thoroughly modern facilities.

General Electric facilities make possible such items as joint-free lead sheathing made in continuous tubes by the famous G-E nozzle-swirl process—Geoprene cables, developed and built exclusively by General Electric—pressure-impregnated paper-insulated cables that are vastly improved by a new manufacturing technique. In fact, in all phases of cable manufacture, new methods keep G-E cables in phase with today's needs.

When you strike a problem that seems to require special manufacturing techniques, call on General Electric. Your G-E cable specialist will be glad to put G-E facilities to your test. *Section W59-827, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.*

You can put your confidence in—

GENERAL ELECTRIC

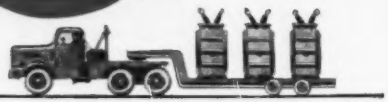
Choose a Multi-purpose FWD 6x6

Choose ability to get more work from Equipment Dollars

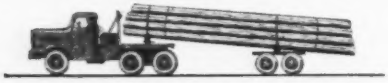
Distributed by Graybar Electric Company

Write Graybar or FWD for data on over 40 different FWD Line Construction and Maintenance units.

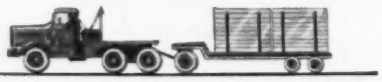
Got a "semi" with a transformer oil purifying unit? Haul it with an H 6 x 6. Fifth wheel recesses in platform.



Transporting heavy transformer is no problem with a low-bed trailer and a powerful FWD H 6 x 6 on the job.



You can take the trouble out of big pole hauling. Bolster fits H 6 x 6 platform quickly and easily.



You can make a train-hitch job for bulky trailer loads. H 6 x 6 platform is free for other equipment.

You'll find FWD H 6 x 6 a sound answer to the need for a multi-purpose utility unit. FWD's extra traction means added safety with better distribution of weight and power—easier going on or off the road. But you'll want to get the complete story on FWD completely-equipped, utility-engineered units.

THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis. • Canadian Factory — Kitchener, Ontario

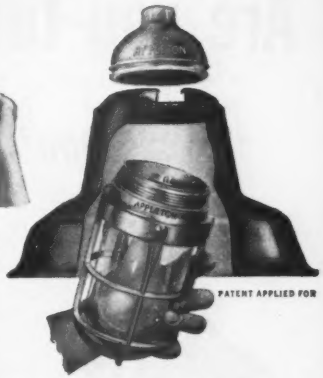
World Wide Sales and Service

America's Foremost Heavy-Duty Truck

A More Economical Connector...

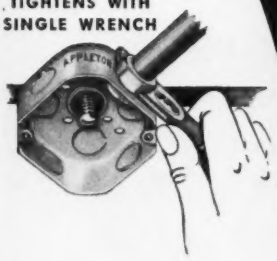
Here is a ½", ¾" or 1" thin-wall connector that costs less, installs faster, provides extra wiring room. Eliminates locknuts. Knurled chamfer bites the rim of the knockout to prevent slippage and provide perfect grounding. *Write for Price Sheet TNI-351.*

A More Efficient Lighting Fixture...



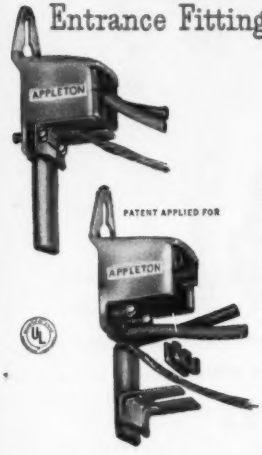
New "V-51" Series. Never before a vaportight lighting fixture so safe, so efficient, so easy to maintain! Exclusive Unit Assembly makes receptacle, globe and guard instantly detachable for re-lamping, *without tools!* Converts for higher or lower wattage lamps just as easily. Reflector has exclusive neoprene rubber ring mount. *Write for Bulletin 5-A.*

TIGHTENS WITH SINGLE WRENCH



APPLETON ENGINEERING, geared to the ever-growing electrical industry, is continually at work to bring you new products - better products - such as the four recent examples shown here...

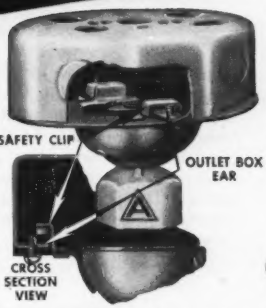
A Simpler, Stronger Entrance Fitting...



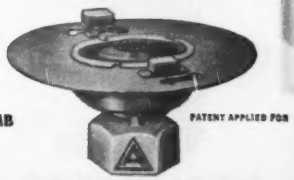
Appleton OF-1 and OF-2 Service Entrance Fittings combine convenience, economy and greater weather protection. Single-piece bodies eliminate need for separate cover on entrance head. No covers to become lost before installation, loosen or dislodge after job is done. *Write for Price Sheet TNI-451.*

A Much Safer Fixture Hanger Cover...

Positive protection against falling! Safety clips automatically position directly above outlet box ears. Permanently joined to the cover, clips will support weight of fixture even if outlet box screws rust through or vibrate out! An exclusive Appleton safety feature. *Write for Price Sheet TNI-551.*



SWIVELS 30° FROM PLUMB



Sold Through Electrical Wholesalers

APPLETON ELECTRIC COMPANY

1701 Wellington Avenue • Chicago 13, Illinois

Branch Offices: NEW YORK, 50 Church St. • DETROIT, 3049 E. Grand Blvd. • CLEVELAND, 1836 Euclid Avenue • SAN FRANCISCO, 655 Minna St. • ST. LOUIS, 227 Frisco Bldg. • LOS ANGELES, 100 N. Santa Fe Ave. • ATLANTA, 724 Boulevard, N. E. • BIRMINGHAM, 429 Brown-Marx Bldg. MINNEAPOLIS, 305 Fifth St., S. • PITTSBURGH, 414 Bessemer Bldg. • BALTIMORE, 100 E. Pleasant St. BOSTON, 10 High Street • DENVER, 1921 Blake Street • PHILADELPHIA, 1017 Cherry Street CINCINNATI, 626 Broadway • HOUSTON, 717 M. & M. Bldg. • HAVANA, Cuba, Malecon No. 9.

Resident Representatives: Binghamton, Dallas, Indianapolis, Kansas City, Orlando, Milwaukee, New Orleans, Seattle, Portland, Ore.

Export Representatives: International Standard Electric Corp., 67 Broad St., New York 4, N. Y.

MALLEABLE IRON CONDUIT FITTINGS

APPLETON

OUTLET BOXES AND SWITCH BOXES

ELECTRIC

INDUSTRIAL LIGHTING EQUIPMENT

PRODUCTS

EXPLOSION-PROOF FITTINGS • REELITE

Are you turning in all your SCRAP?

Don't wait for "George" to do it

You'll find your local scrap dealers listed in the yellow pages of the phone directory.

IF you are a steel user, this important job of getting more scrap back to the mills is directly up to *you*. You just cannot afford to sit idly by while the scrap shortage gets worse. For unless everyone really pitches into this job of digging out all the scrap possible, steel production is bound to suffer, and every steel user, in more or less degree, will suffer too.

More scrap means *more* steel—it's as simple as that.

Right now some mills have only a bare two-days' supply of scrap on hand. Others have even less. Some steel-making furnaces already have had to shut down for lack of scrap. The situation is serious. Only you can help improve it.

By turning in every piece of worn-out equipment, every obsolete tool and machine, in fact every pound of iron and steel scrap you can comb out of your plant, you'll be helping relieve the worst scrap shortage since Pearl Harbor days . . . and the steel industry will be able to produce more of the steel you need.

Remember—it takes at least one-half ton of scrap to make one ton of steel. To maintain steel's present high production schedules requires more than 1400 carloads of industrial scrap *every* day. So turn in your scrap—ALL your scrap—and keep the mills rolling. This is more than a shortage. It's an emergency that vitally concerns you—and us—and the Nation.

This page would ordinarily be used to tell you about

OUR STEEL WAREHOUSE SERVICE

but, because steel cannot be produced without SCRAP, we are asking instead for your all-out help in getting more SCRAP to the mills.

UNITED STATES STEEL SUPPLY COMPANY
WAREHOUSES COAST-TO-COAST

USS

1-1348-A

UNITED STATES STEEL

DIAMOND *Leads* WITH REHEAT TOO!

Over 8,000,000 kw* of Postwar Reheat Boiler Capacity Has DIAMOND SOOT BLOWERS Already Installed or On Order (see list)

Wisconsin Electric Power Co.
Pt. Washington

Boston Edison Co.
Edgar

Appalachian Electric Power Co.
Philip Sporn

Indiana Michigan Electric Co.
Twin Branch

Indiana Michigan Electric Co.
Tanners Creek

Niagara Mohawk Power Corp.
Oswego

Dayton Power & Light Co.
Hutchings (Units 1 and 2)

New England Power Co.
Salem

Pennsylvania Power Co.
New Castle

Duke Power Co.
Lee

Public Service Co. of Northern Ill.
Waukegan

New York State Gas & Elec. Co.
Goudey

Public Service Elec. & Gas Co.
Sewaren

Union Electric Co.
Meramec (Unit 1)

Central Hudson Gas & Elec. Co.
Danskammer

Consumers Power Co.
Erie

Jersey Central Power & Light Co.
So. Amboy

Cincinnati Gas & Elec. Co.
Clermont (Unit 1)

Central Illinois Public Serv. Co.
Hutsonville

Duke Power Co.
Riverbend

Duke Power Co.
New

Niagara Mohawk Power Corp.
Albany

Carolina Power & Light Co.
Goldsboro

Carolina Power & Light Co.
Lumberton

Consolidated Edison Co.
Astoria

Virginia Electric & Power Co.
Chesterfield

Philadelphia Electric Co.
Delaware

Illinois Power Co.
Hennepin

Illinois Power Co.
Wood River

American Gas & Electric Co.
Kanawha

American Gas & Electric Co.
Muskigum

Dayton Power & Light Co.
Hutchings (Units 3 and 4)

Commonwealth Edison Co.
Ridgeland

Public Service Elec. & Gas Co.
Kearney

Pacific Gas & Electric Co.
Moss Landing

Cleveland Electric Illum. Co.
East Lake

Tennessee Valley Authority
Plant A

N. Y. State Gas & Electric Co.
Greenidge

Cincinnati Gas & Electric Co.
Clermont (Unit 2)

Union Electric Co.
Meramec (Unit 2)

Wisconsin Power & Light Co.
Beloit

Jersey Central Power & Light Co.

Kansas City Power & Light Co.
Hawthorn

*Based on list included in paper "The Trend Toward Reheat" presented at Midwest Power Conference, April, 1951. List above incomplete—soot blowers for some reheat boilers still pending.

4553

DIAMOND
POWER SPECIALTY CORP.
LANCASTER, OHIO

DIAMOND Economy Matches REHEAT Economy

PLP Dead-Ends+

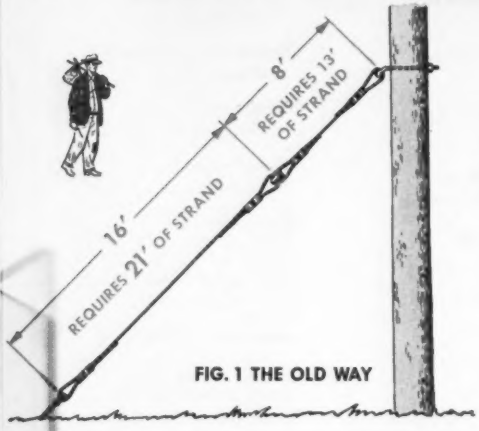
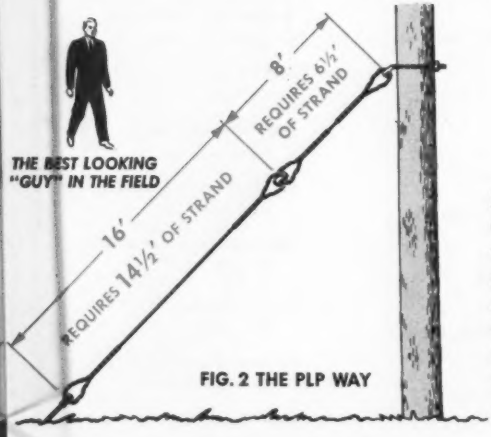


FIG. 1 THE OLD WAY



THE BEST LOOKING "GUY" IN THE FIELD

FIG. 2 THE PLP WAY

With PLP Dead-Ends, you save critical guy strand and get stronger, safer guys. For example, let's consider the 24-foot, 6000# guy (Fig. 1). Doing the job in this conventional way, using Siemens-Martin Strand, requires:

13′ of ⅜″ strand (TS 6950#)
weighing 273#/1000′ = 3.549 lbs.

21′ of ⅜″ strand (TS 6950#)
weighing 273#/1000′ = 5.733 lbs.

9.282 lbs.

But the equivalent PLP Dead-End installation (Fig. 2) using 3-wire Extra High Strength strand, requires only:

6½′ of ¼″ EHS strand (TS 6600#)
weighing 116.7#/1000′ = 0.759 lbs.

14½′ of ¼″ EHS strand (TS 6600#)
weighing 116.7#/1000′ = 1.692 lbs.

2.451 lbs.

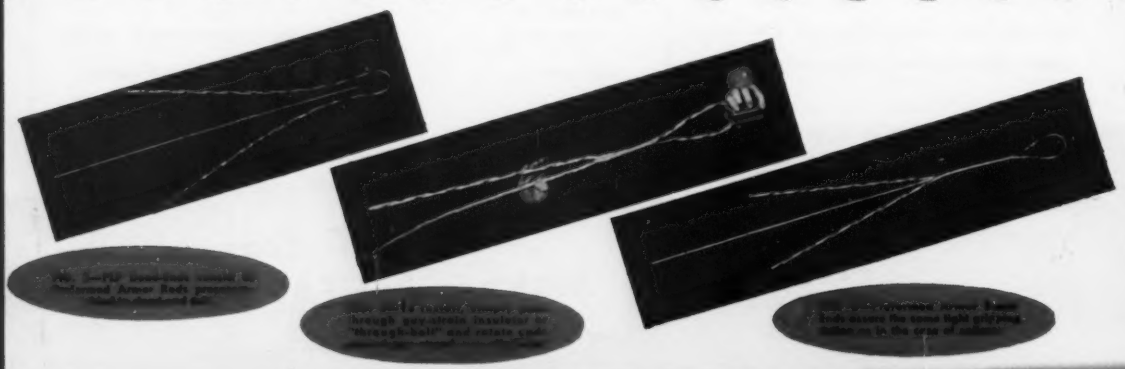
SAVING --- 6.831 lbs.

Making this Guy the PLP way results in a saving of 73% of critical guy strand . . . and you eliminate the need of any clamps.

With PLP Dead-Ends, even wrenches are not needed. Simply install by hand! (Fig. 4) Any lineman . . . regardless of his skill . . . can do a perfect job every time. *Installation time is cut in half.*

Substantial dollar savings are the result even with "B" and "C" coated strand.

And PLP Dead-Ends are stronger than the strand. See opposite page.



= 73% Saving of Guy Strand

STRAND STRENGTH EXCEEDED by PLP DEAD-ENDS

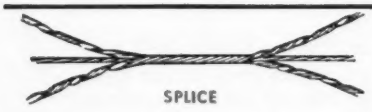
Recently, one of the best known electrical laboratories tested the static strength and the d-c resistance* of various splices and dead-ends. The engineers found one system far better than the rest. So much better that you will want to see their testing procedure and test results.

HERE'S WHAT THEY DID

7-STRAND CONDUCTOR

FIG. 6

They took two sections of 3/8", 7-strand extra high-strength galvanized steel (catalog strength: 11,200 lbs.)



SPLICE

FIG. 7

Spliced them together, *by hand,* with *Preformed Armor Rods.*

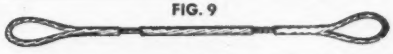
*Name on request

DEAD END

FIG. 8

Then attached dead-ends of *Preformed Armor Rods* to both ends . . . using no tools, clips or clamps.

FIG. 9



DEAD END SPLICE DEAD END

Placed the specimen in a tensile testing machine. Measured the d-c resistance (through both dead-ends and the splice) under no load and under loads up to 5000 lbs. Continued loading until the specimen failed. Compared these results with an unbroken conductor of equal length.

HERE'S WHAT THEY FOUND

Preformed armor splices and dead-ends averaged at least 40% more conductivity than the unbroken cable every time the test was made.

Preformed armor splices and dead-ends proved stronger than the unbroken conductor. Breaks always occured in the section not protected by the *Preformed Armor Rods* . . . at about 10% more than the rated strand strength of 11,200 lbs.

PREFORMED

LINE PRODUCTS CO.

CLEVELAND 3, OHIO

The use of Preformed Armor Rods for making better guys, is just one of the many applications of these revolutionary new rods. Utilities throughout the country are finding that they are invaluable for support armor, repair armor, splices, jumpers, ground strand armor, tie wire, dual-conductor spacers, lashing armor, dampers and suspension clamp jumpers. For complete information regarding any or all of these applications, just write to: PREFORMED LINE PRODUCTS COMPANY, 5349 St. Clair Avenue, Cleveland 3, Ohio.

NOW... practical, low-cost demand metering of even small kw loads!

SINGLE OR POLYPHASE CIRCUITS

To help you achieve all-important economy in the metering of kw demand, Westinghouse continues to develop and improve devices for every application in this field. The result is . . .

A complete line of kw demand type equipment . . . one that fulfills all of your present needs and anticipates many of your future requirements!

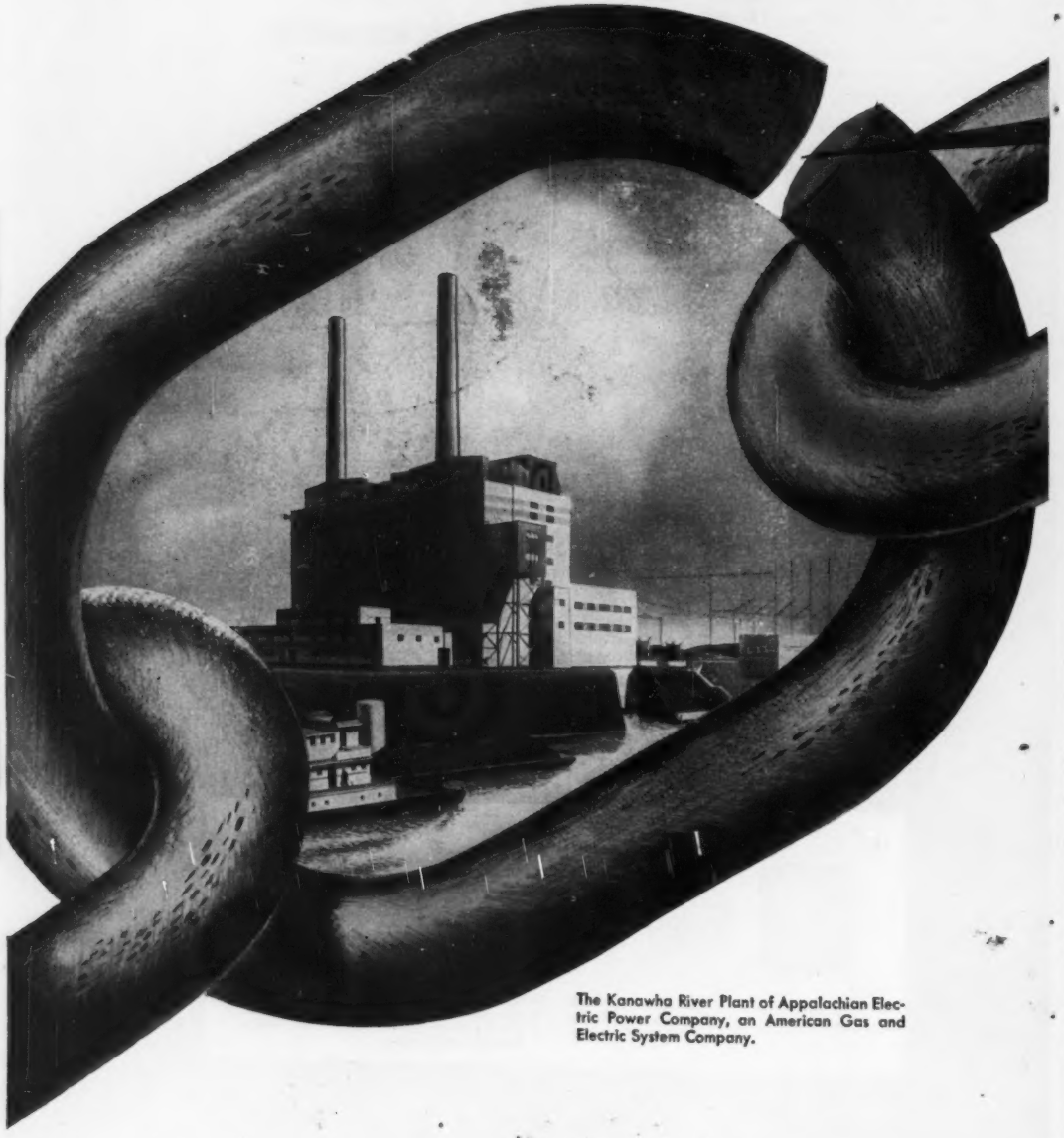
The improved CSH single-phase meter and the new CSH-8 polyphase unit (illustrated here) are typical examples of the way Westinghouse pioneers to produce savings for you. Into the CSH meter have gone many new improvements to make it easier, and more practical for you to measure demand on single-phase loads. And the new CSH-8 is the first thermal demand unit available in a socket base for polyphase circuits. Both units combine standard watthour meters with practical thermal demand meters—in a single case—to answer your need for low first cost . . . lower installation and maintenance costs.

In the complete line of Westinghouse metering equipment you'll spot many opportunities for savings. So whether your needs involve large loads or small, single or polyphase circuits, kw or kva, call on Westinghouse.

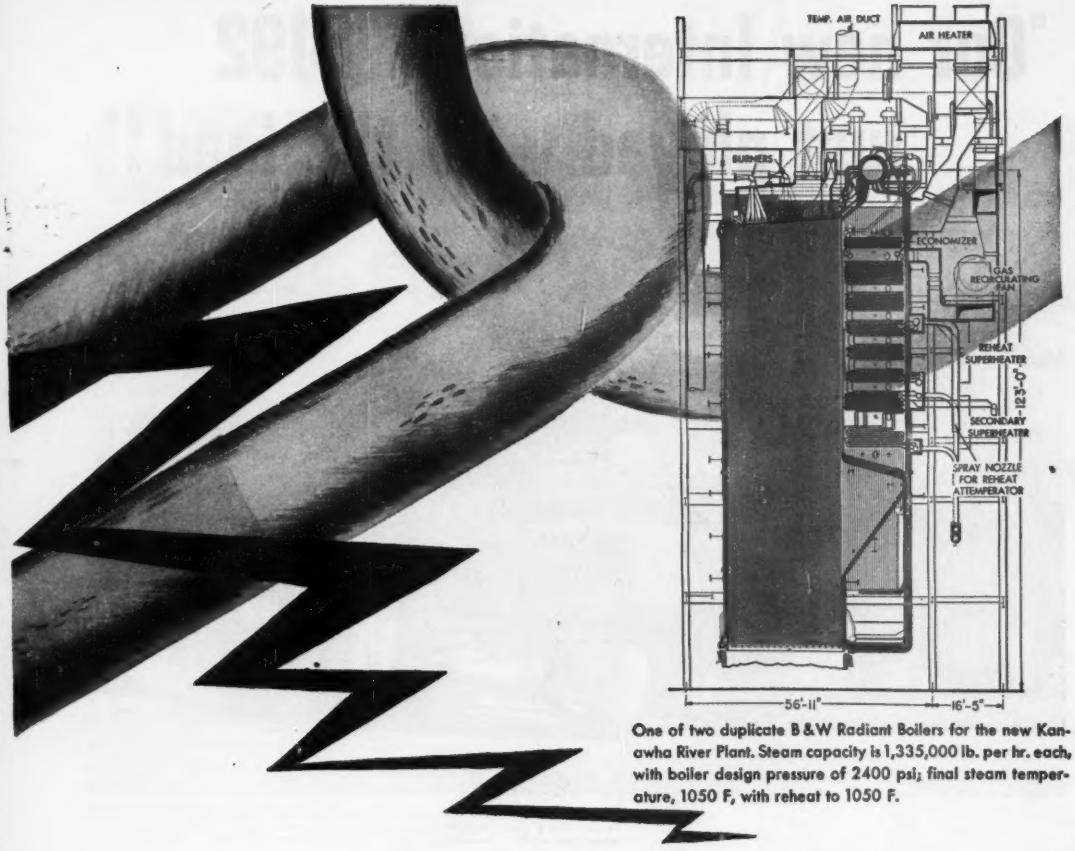
For complete information on CSH Meters write for Catalog Sections 42-337 and 42-338. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-40394

NEW!
Type CSH-8 socket-type, combination watthour and thermal watt demand meter for polyphase circuits.
SIMPLIFIED INSTALLATION One mounting for both watthour and thermal demand meter.
LOW MAINTENANCE Simple thermal action provides same low-maintenance characteristics as standard watthour meters.
MINIMUM SIZE Over-all dimensions are the same as for a three-element watthour meter except for the increased depth of the demand-type cover.
IMPROVED!
Type CSH combination watthour and thermal demand meter for single-phase circuits. Now available—high-capacity, 50-ampere, 240-volt, 48-kw demand.
WESTINGHOUSE
THERMAL WATT DEMAND WATTHOUR METER
THERE'S A WESTINGHOUSE METER FOR EVERY APPLICATION!
Recording kilowatt demand meters.
Block interval, indicating and accumulative demand registers.
Single or polyphase combination watthour and thermal watt demand meters.
Switchboard-type combination thermal watt demand meters.

KANAWHA



The Kanawha River Plant of Appalachian Electric Power Company, an American Gas and Electric System Company.



One of two duplicate B&W Radiant Boilers for the new Kanawha River Plant. Steam capacity is 1,335,000 lb. per hr. each, with boiler design pressure of 2400 psi; final steam temperature, 1050 F, with reheat to 1050 F.

Forging the Future of AMERICA'S POWER

A monument to faith in America's future power is rising in the Kanawha Valley—where the Kanawha River generating plant of Appalachian Electric Power Company will ultimately link a million new kilowatts to the massive forge of U.S. production for defense and peace.

Part of a quarter-billion dollar expansion budget, Kanawha will start up with the world's two largest single-boiler generating units—2,670,000 lb. per hr. combined total steam capacity, serving a round-the-clock gross generating capability of 434,520 kw . . . almost double the present demand of all industrial and residential customers in the area it will serve.

Kanawha's boilers are *big*. Their furnaces, of the divided-type, will have the highest heat-input of any boilers ever built—1,860,000,000 BTU per boiler, per hour . . . and the two boilers will burn over a million tons of coal yearly. Boiler design incorporates two of the latest B&W-pioneered features: pressurized furnaces and gas-recirculation . . . the latter combined with spray attemperation in the superheater to give steam-temperature control over a wide range of capacity.

With their large reheat capacity, high temperature-pressure characteristics, and the additional efficiencies inherent in pressure-furnace operation and recirculation of flue-gases, these units will contribute much to the expected plant heat-rate of 9,035 BTU per net kw-hr. . . . probably the lowest ever attained.

Kanawha is a striking testimonial to the fact that 67 years of phenomenal improvement in power generation have not dulled the industry's keen sense of progress. Courage and far-sightedness of our power companies, and their confidence in supplier organizations, will surely continue to forge new links in the chain of technological development that has made this industry, and the millions it serves, a continuing power in America's greatness and strength.

BABCOCK & WILCOX

G-5401

"Our new International L-192 just played with the load!"

This International L-192 with special utility body and winch recently went to work for People's Gas & Electric Co., Mason City, Iowa. Vehicle weight empty—15,000 pounds. Wheel Base — 175". 5-Speed transmission. Single-speed rear axle; Ratio: — 7.16 to 1.

When the driver of a new truck says: "It just *played* with the load," that statement *means* something.

In the case of this new International L-192, it meant "playing" with several 55-foot telephone poles and 4 *heavy* transformers the first day the truck was on the job. That's the kind of right-for-the-job performance you can expect from *every* International . . . from the smallest pick-up to the biggest model in the line.

Here's why:

1. Internationals are *heavy-duty engineered* to give you true truck stamina that keeps 'em running stronger, longer and at lower cost to you . . . no matter *what* job they have to do!

2. Internationals have the **COMFO-VISION CAB**—the *roomiest* on the road! Deep-cushioned seats, controlled heat and ventilation, *plus* perfect visibility through that big, one-piece Sweepsight windshield make this cab a driver's dream come true.

3. Internationals have new *valve-in-head engines*—proved and perfected in the world's largest all-truck engine plant to give you efficient balance of power, speed and economy.

4. Internationals are the world's most complete line of trucks, with 87 basic models and thousands of specialized variations, with Gross Vehicle Weights varying from 4,200 pounds all the way up to 90,000 pounds.

5. Internationals can be speedily serviced, because the International Truck you buy is backed by the world's largest, most complete, best equipped *exclusive* truck servicing system.

For the complete story see your nearest International Truck Dealer or Branch soon.

International Harvester Builds McCormick Farm Equipment and Farmall Tractors . . . Motor Trucks . . . Industrial Power . . . Refrigerators and Freezers

International Harvester Company • Chicago

See the new

INTERNATIONAL TRUCKS

Every model heavy-duty engineered for longer life

You get GREATER ultimate strength

in L-M's new reinforced wireholder

L-M's new wireholder is as tough and strong as they come. In over-all comparative tests it exceeded most others tested based on both dead-end pull and 90° side pull.

It was developed only after extensive tests of a number of designs, in order to give you the greatest possible ultimate strength.

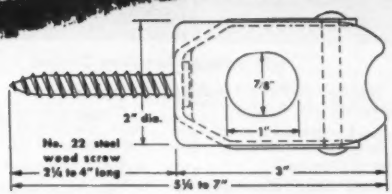
Screw is long, sharp, firmly fixed—with choice of screw lengths from 2¼ to 4 inches. With porcelain base directly against the wood, there is less danger of cracking the porcelain than when it is in contact with a metal ring. Porcelain has a good, well-rounded design, to avoid abrasion of wire.

It's a good wireholder, typical of the many line construction materials L-M offers.

COMPARATIVE STRENGTH TESTS

TYPE AND MAKE OF WIREHOLDER	AVERAGE ULTIMATE STRENGTH, POUNDS	
	Dead End Pull	Side Pull, 90°
L-M New	1800 lbs.	1600 lbs.
L-M Old	1750	1500
Make A	1600	925
Make B	1100	975
Make C	2300	825
Make D	1800	925

IMPROVED DESIGN OFFERS GREATER RESISTANCE TO DEAD-END AND SIDE PULL



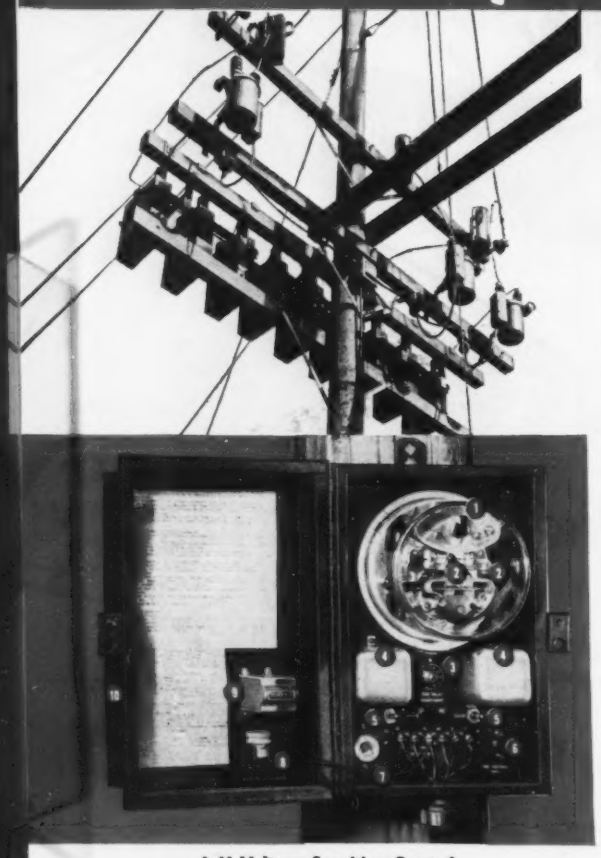
Want samples, prices?
Ask the L-M Field Engineer; or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

LINE MATERIAL
Line Construction Materials

Complete Coordinated Equipment for Distribution Today

this 225 kvar automatic

switched capacitor installation



L-M Voltage-Sensitive Control

1. Nominal line adjustment on voltmeter—110 to 130 v.

2. Band width adjustment—2 to 12 v. with recommended minimum of three volts.

3. Time delay adjustment—instantaneous to 4½ minutes. Synchronous motor drive unaffected by variation in ambient temperature or voltage.

4. Enclosed selector relays—carry full burden of oil switch driving mechanism.

5. Toggle switches permit automatic, test, or instantaneous manual operation of oil switches.

6. Line voltage test connections.

7. Fuse protects entire circuit.

8. Spare fuse plug.

9. Operation counter (optional).

10. Weather-proof cabinet with threaded conduit nipple and multiple knockouts.

Less than $6.37 per kvar

for equipment including
Elemex Capacitors, Kyle Type GR Switches, New L-M Voltage-Sensitive Control, Capacitor Racks, Cutouts, and Arresters

(Only $5.92 per kvar for 300 kvar bank for 4160 volt delta or 2400 volt wye.)

This unprecedented low cost of $6.37 per kvar for small banks of automatically switched capacitors is made possible through the introduction of L-M's new control equipment. At this low cost you are now justified in installing and taking advantage of all the dollar benefits switched capacitors can give you.

L-M's New Voltage-Sensitive Control

L-M's new voltage-sensitive control has been field-tested for more than two years, and is now in full production. Although fundamentally designed for controlling the Kyle type GR oil switch, its flexibility permits its use with other solenoid or motor-driven equipment, including large breakers.

Heart of the control is basically a watt-hour meter modified to make it volt-sensitive. Over 3/16" contact travel per volt (120 volt base) assures extremely sensitive operation. Voltmeter is temperature compensated to ±1% accuracy from −30° F to 140° F. Line voltage can be determined within this accuracy without the use of external portable instruments. Once band width and midpoint settings are established, they are accurately maintained and need no periodic checking.

Voltmeter is mounted in a standard meter socket. Installation can be completed and tested before meter is installed, so that the test engineer doesn't need to be present until the line crew has finished its work.

Arc-suppression and filter circuit assures complete freedom from interference at telephone, radio, or television frequencies.

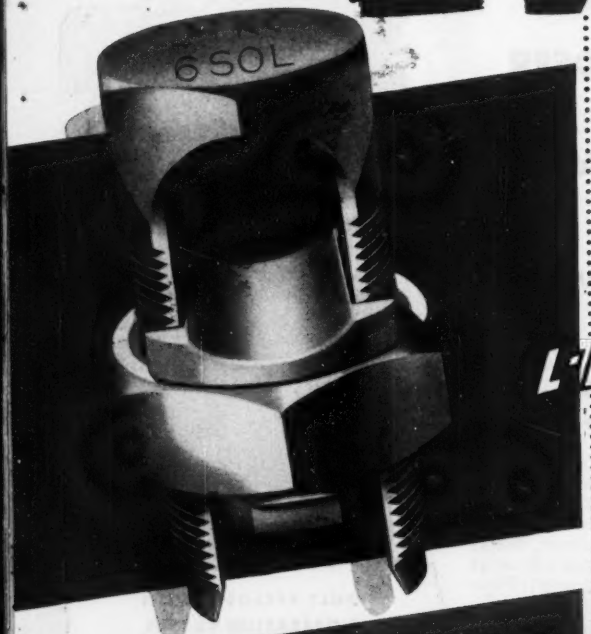
Get the whole story. Ask the L-M Field Engineer for bulletin on Elemex Capacitors and information on L-M's complete switched capacitor installation and the new voltage-sensitive control; or write Line Material Company, Milwaukee 1, Wis. (a McGraw Electric Company Division).

LINE MATERIAL Capacitors

Completely Coordinated Equipment for Distribution Today

How to make a good connection with L-M connectors

One of the best ways to make permanent, low-resistance connections is to select the best connector for the job. There are many connectors on the market; L-M offers a complete line, including some types not otherwise available. This page shows just a few. But for complete information, get in touch with the L-M Field Engineer, who can work with you on connector and splice problems. Call the nearest L-M Field Office. Or write for copy of our connector bulletin SC1. Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).



L-M KYLE Split Bolt Connectors

Heavy-bodied Kyle connectors are machined from heavy stock. They have clean, accurately machined threads, smoothly rounded edges, close-fitting pad. The nut tightens easily, and the pad slides up smoothly to grip the wire solidly. There's little chance for distortion of these solid connectors, and they'll stand re-use—which makes them economical. For all wire sizes from No. 10 solid to a million circular mills. Available for copper, copperweld, aluminum, or galvanized iron wire. In several types, to assure minimum corrosion.

L-M Fargo Automatic Line Splice

Here is a very fast, easy-to-use splice that just won't slip. In pull tests, the wire breaks before it slips out of the splice. You just stick the ends of the wire into the ends of the splice, give it a tug to set the clamps—and the job is done. No tools needed! Wire readily released so splice can be re-used. Widely used for permanent splices; superlative for emergency work. For solid or stranded copper or copperweld; *not suitable for galvanized iron;* for sizes from No. 8 to 500 MCM stranded.

L-M Fargo Vise Type Connector

Left: An exclusive type with many advantages. One-piece construction, no parts to lose; always threaded; no time lost in starting the nut. An easy unit for linemen to handle and install. Bolts forged and rolled for extra strength. Develops approximately 10 pounds compression for every inch-pound of wrench torque. Binding action of vise-type construction gives a vibration-proof connection. High salvage value. Made of Everdur (bronze) for copper connections and plated Everdur for all-purpose use on copper, aluminum, or galvanized iron wire. Available for wire sizes No. 8 to 1000 MCM.

Right, above: Fargo B-3 Lashing Wire Clamp: hot-dip galvanized malleable iron. One-piece construction. Holds lashing wire to messenger to its full breaking strength. For any size lashing wire and for messengers up to and including ½ inch (25M stranding).

LINE MATERIAL Connectors

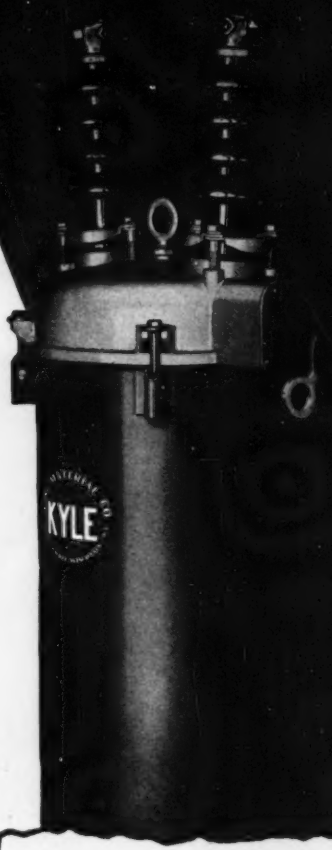
Complete Coordinated Equipment for Distribution Today

KYLE

TYPE "L" OIL CIRCUIT RECLOSER NOW GIVES YOU UP TO

6000 amps interrupting capacity

IN NEW 140-AMP RATING



First recloser actually engineered for heavy-duty service ... full power-class design ... 110 kv insulation impulse level ... ratings up to 140 amps ... only real heavy-duty recloser in its class

Kyle type "L" reclosers cost a little more than lighter-duty reclosers, but they're worth the difference in service, performance, convenience, and freedom from maintenance. Even if you don't need the extra interrupting capacity now, you will need it to take care of future loads; and in the meantime you enjoy all the benefits of type "L" performance and economy.

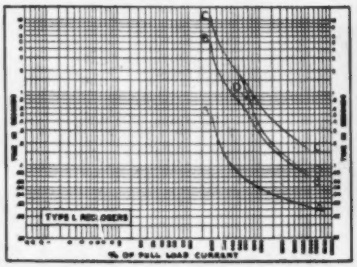
It's the Kyle oil cross-blast method of arc extinguishing, plus heavy-duty design, that makes it possible for the "L" to handle heavy fault currents up to 6000 amps.

The type "L" is the only recloser with so wide a choice of operating sequences. Four standard curves permit any sequence of operation to meet your coordination problems.

Sequence and coil changes are made right in the field—in a few minutes. To change to a coil of different rating, you just remove two screws. To change operating sequence, simply rotate a disc or change one small part. It's quick—and easy! Saves shop trips!

Extremely accurate; virtually no effect from ambient temperature changes. Positive fast operation; positive toggle closing—doesn't depend on gravity. Many safety features: cover and tank electrically dead—bushing tops only live parts; trip-free operating handle. Large sleet hood protects counter and operating handle; may be rotated in 90° steps. Rugged; shock-proof; trouble-free.

ONLY RECLOSER WITH 4 OPERATING CURVES



RATINGS

Coil Rating Amperes	Min. Trip Current Amperes	Maximum Interrupting Capacity Amperes At Maximum Phase-to-Phase Nominal Voltage of		
		4.8 kv	7.2 kv	14.4 kv
25	50	1500	1500	1500
35	70	2100	2100	2100
50	100	3000	3000	3000
70	140	4200	4000	3000
100	200	6000	4000	3000
140	280	6000	4000	3000

Read all about it!

Ask the L-M Field Engineer for a copy of Bulletin CR1A—on the type "L"; or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

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LM LINE MATERIAL...Kyle Reclosers

Complete Coordinated Equipment for Distribution Today

Accuracy...

ONE IMPORTANT REASON WHY
KYLE RECLOSERS OUTSELL ALL OTHERS

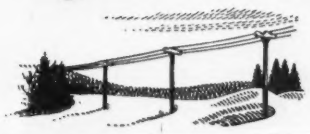
Accurate because they're built that way. Because we make so many reclosers, we have excellent machining facilities, extremely high quality standards and close tolerances, and extensive engineering and field experience. Each recloser is individually tested. The result is a very uniform product that assures accurate coordination.

Precise Hydraulic Mechanism: Does not depend on gravity; no clock-work, coil springs, or mechanical moving parts. A very consistent and accurate timing sequence is maintained. Kyle Reclosers are now supplied with ORTO®, L-M's oxidation-resistant transformer oil, inhibited for longer oil life.

Greater Convenience: You can change coils and timing sequence right in the field—in a few minutes. No shop trips to change ratings or sequences—it's easier to maintain coordination!

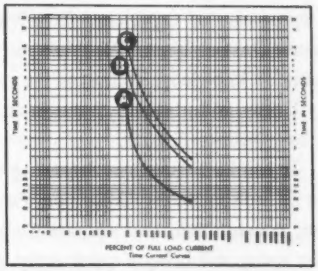
Here's the Kyle type H single-phase recloser. Has all the Kyle safety features. For 2.4 to 15 kv; six ratings from 5 to 50 amps; trip currents 10 to 100 amps; interrupting capacities from 150 to 1200 amps.

Also available in Kyle type 3H three-phase recloser, which recloses and resets individually on each phase to clear temporary faults; but if fault does not clear after three operations, it locks out *all three phases simultaneously* on the fourth tripout.



Satisfactory at wide range of temperatures. The design of the recloser makes it dependable at all temperatures—from 120° above to 20° below, says one user. Another large user, in Canada, says Kyles give complete satisfaction down to 58° below zero.

Installing a Kyle type H on a rural line in the West. Thousands and thousands of Kyle reclosers are in use all over the world.



Wider Choice **of operating curves and sequences. Kyle type H is the only recloser that offers three time-current curves—(A) fast, (B) retarded, (C) extra retarded. You can mix or match 'em almost any way you like—seven possible combinations.**

Ask the L-M Field Engineer what others are doing with Kyles. And ask him for a copy of our recloser bulletin. Or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

LINE MATERIAL
Kyle Reclosers

Complete Coordinated Equipment for Distribution Today

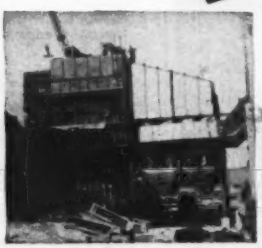
This 'dust' man can be your best friend

If you ask him about the Most Efficient, Most Economical Method of collecting Nuisance Dust

Wherever objectionable dust goes uncontrolled, you aggravate employee morale; you impair plant-community relations.

In either case, a Buell "dust" man can probably help. That's his job, and he is backed by more than 200 man-years of experience in solving industrial Nuisance Dust problems. We think you'll agree, too, that Buell's knowledge of dust is the reason why so many Utility and plant operators include us among their best business friends.

If you have questions regarding the latest advance in nuisance-dust Collection Equipment—its design, construction, and operating characteristics, a letter today will bring a quick reply. And—ask for the new, self-indexed Buell Dust Collection bulletin. Buell Engineering Company, Dept. 60-H, 70 Pine Street, New York 5, N. Y.



Buell van Tongeren Cyclone in series with Electric Precipitator provides high efficiency collection of Fly Ash at a large Eastern Utility.

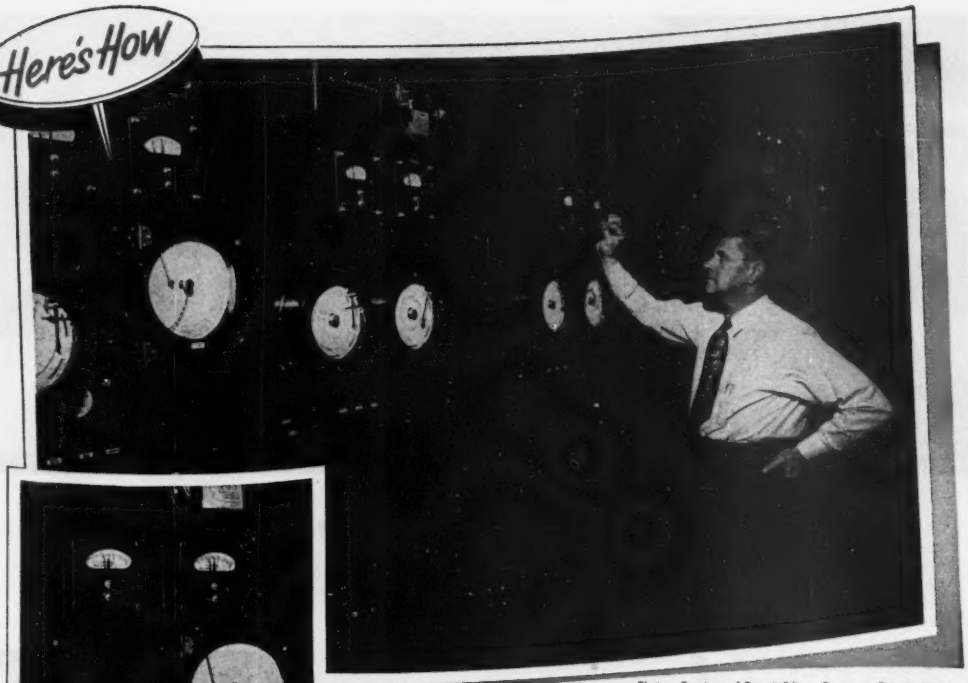
buell®

ELECTRIC CYCLONIC

HIGH-EFFICIENCY CYCLONES
ELECTRIC PRECIPITATORS
"LR" COLLECTORS
LOW DRAFT LOSS COLLECTORS
SPECIAL PURPOSE COLLECTORS
DUST HOPPER VALVES

ENGINEERED EFFICIENCY IN DUST COLLECTION

Here's How



Photos: Courtesy of Detroit Edison Company, Detroit, Mich.

You can get the maximum out of your existing Distribution Equipment

LINCOLN TYPE AD-2
Ampere Demand Meters

LINCOLN TYPE CCA
Graphic Demand Meters

To load your distribution system to the ultimate safe limit, you *must* know the load on your feeders. Lincoln Ampere Demand Meters give you the facts you need—on the basis of *continuous* information—to keep the loads between feeders balanced.

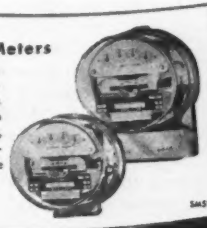
Type AD-2 Thermal Ampere Demand Meters show the demand on the feeder phases at all times as well as the maximum demand reached since the last manual resetting.

Type CCA Graphic Ampere Demand Meters provide an accurate and reliable means of ascertaining this information wherever a record of the time and duration, as well as the magnitude, of the demand is required.

Bulletins 450, 461 and 467 tell the whole story—write for your copies.

Sangamo J Meters

These watthour meters meet today's requirements and tomorrow's anticipated loads with sustained accuracy, economy of maintenance and troublefree performance.

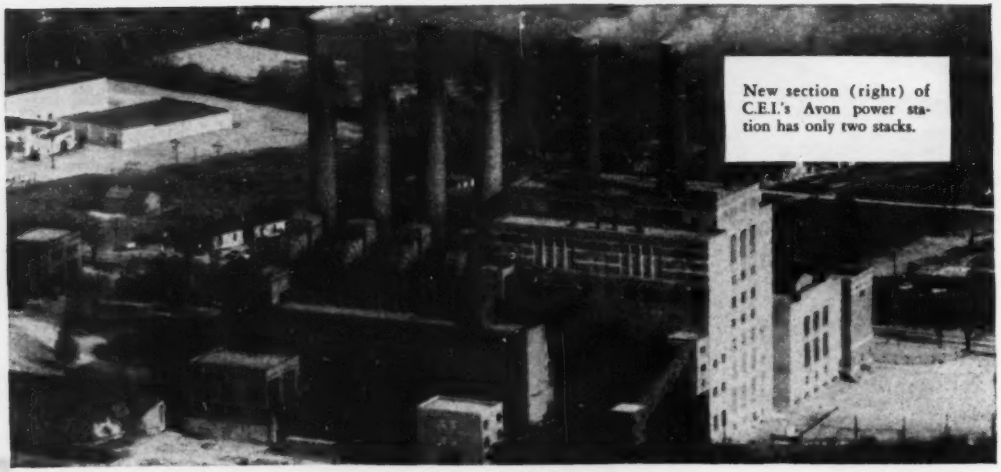


SA451-4

SANGAMO — *Only Measured Facts are Known Facts*

SANGAMO ELECTRIC COMPANY

SPRINGFIELD, ILLINOIS

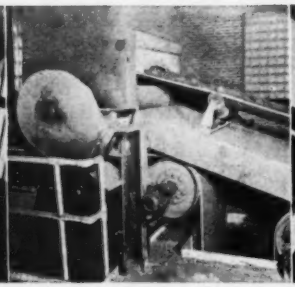


New section (right) of C.E.I.'s Avon power station has only two stacks.

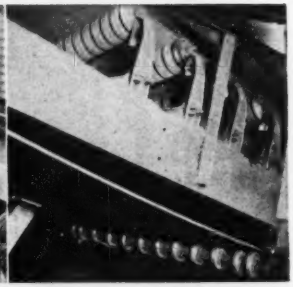
25 years ago... and again today...

Cleveland utility relies on LINK-BELT

On its way to crushers from railroad car dumper hopper, coal moves on a 48 in. wide, 218 ft. long Link-Belt belt conveyor equipped with Series 100 idlers.



Differential back-stop and gravity take-up at head end of this belt conveyor assure trouble-free operation.



Rubber treads save belt at foot end —upper idlers absorb shock of falling coal, lower one cleans its surface.

LINK-BELT integrates coal handling system for old and new sections of Avon generating plant

WHEN the Cleveland Electric Illuminating Co. nearly doubled the capacity of its Avon station, Link-Belt was the logical source for coal handling equipment. For, when the original plant was built in 1926, it was Link-Belt equipped.

Part of the original conveying system—still going strong—is retained in the new set-up which can deliver 1000 tph to the new section's bunkers, split the 1000 tph between old and new sections, or merely carry 500 tph to the old section. Included in the system are automatic methods for maintaining belt tension and alignment, for sampling, for arresting backward travel in the event of power interruption, and for stopping conveyors in proper sequence should trouble occur.

True 25 years ago . . . true today. Link-Belt is your best bet for coal handling. Nowhere else can you tap such resources of experience, engineering, quality equipment and completeness of line. Whatever the size or type of your plant, Link-Belt engineers can help you come up with the right answer for more efficient coal handling.

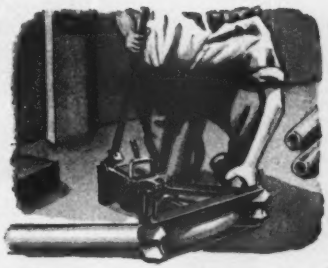
12.347

LINK-BELT

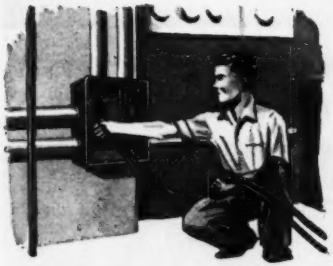
COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices in Principal Cities.

"Hey Boss, we finished two hours early!"



We used Triangle conduit and wire all the way through and right from the start things went smooth. Take the conduit, for instance. This Triangle hot-dipped galvanized conduit bends easy and what I like best is that it doesn't flake on the bends. We really saved time working with conduit like that.



We used Triangle power cable and varnished cambric—lots of it! This big stuff is easy to handle and we saved plenty of time there. Every foot was right, nothing to reject.

On the branch circuits we used Triangle's Glazon. It's got a smooth finish and small outside diameter that makes it easy to pull, and it's free stripping.

That's about it, Boss. We can go over to that other job now — the one we didn't think we could tackle until tomorrow.

Yes-Sir, when it comes to quality wire, cable and conduit — Triangle *Must* Be Right! Why don't You specify Triangle on *Your* next job? Ask your jobber — he knows, It *Must* Be Right.

THE TRADE-MARK OF TOP QUALITY!

TRIANGLE CONDUIT & CABLE CO., INC.

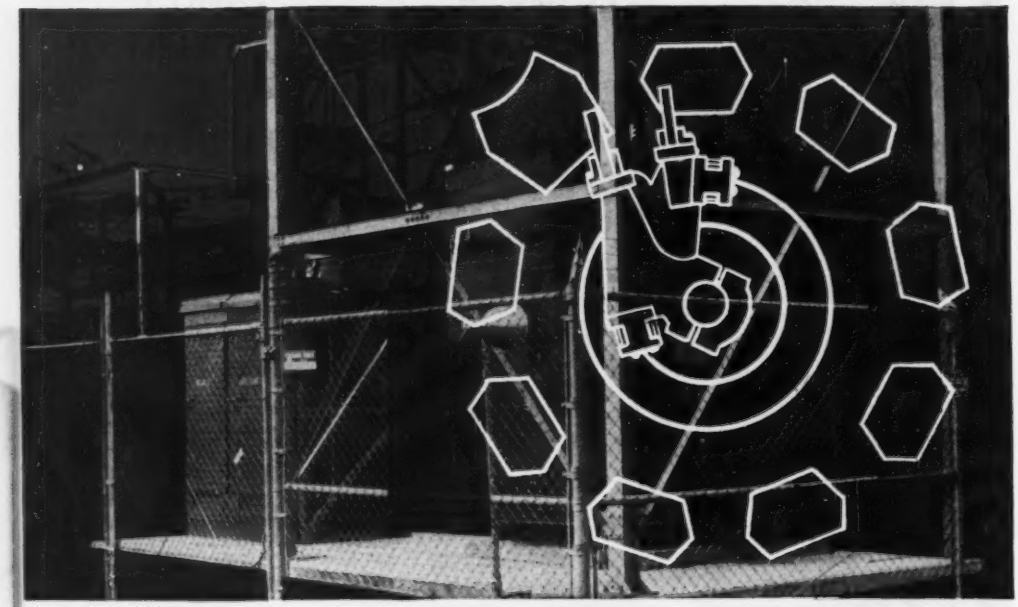
NEW BRUNSWICK, NEW JERSEY

IT *MUST* BE RIGHT

"Glazon" Building Wire • Glazon Non-Metallic Sheathed Cable • Armored Cable • Service Entrance, Service Drop, Varnished Cambric Braided or Leaded, Trioprene Trench, Power and Parkway Cables • Bare Wire • Rigid Conduit Hot Dipped Galvanized • Electric Metallic Thin Wall Conduit • Flexible Steel Conduit

ELIMINATE ALL ARCING

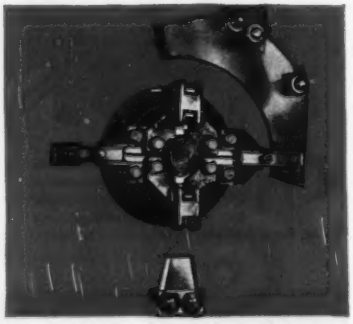
ON TAP SELECTOR SWITCH CONTACTS WITH . . .



. . . MOLONEY LOAD TAP CHANGERS PROVIDED ON FEEDER VOLTAGE REGULATORS, REGULATING TRANSFORMERS, LOAD RATIO CONTROL TRANSFORMERS

All Moloney Feeder Voltage Regulators, Regulating Transformers and Load Ratio Control Transformers are provided with Load Tap Changers which feature a load transfer switch to relieve the tap selector switch of all arcing duties. The load transfer switch has only four stationary contact tips per phase as compared with eighteen on the tap selector switch. This arrangement not only reduces the number of contacts subject to arc erosion, but also permits longer arc clearances to assure positive break of the arc. Liberal clearances of current carrying parts result in maximum capacity of the regulating equipment with minimum physical size. The load transfer switch, which is the only switch required to transfer load current, is provided with accelerating springs and is driven by Geneva gears. This assures quick break of the arc.

This is but one of the many features of the Moloney Load Tap Changer. This same sound basic construction is found in the regulating apparatus on which the tap changer is used.



Liberal clearances prevent establishment of an arc between adjacent current carrying contacts of the load transfer switch. Special alloy arcing tips prevent damage to the switch contacts as they are opened or closed.

M221-10

MOLONEY ELECTRIC COMPANY

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control Transformers • Step Voltage Regulators • Unit Substations

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

Editorials

Steam Station Costs

Cost comparisons of elements of the electric power industry are usually difficult to compile and quite unreliable for accurate analysis. Design variations because of climate, fuel, capacity requirements, service area, and other factors create this difficulty. For this reason, it is ordinarily impossible to test one system or plant against another to establish a measure of performance. One exception to this rule is the Steam Station Cost Surveys made by "Electrical World."

With the cooperation of 48 utilities, we have been able to compile sufficient data on plants of varying sizes to provide excellent comparisons. In this issue of "Electrical World" we are publishing the 7th Steam Station Cost Survey. It covers 5 million kw of plants built in the past three years. All important capital and operating expense items are segregated.

This cost study can be an invaluable tool for managements in checking their own facilities and in planning the additional 33 million kw scheduled for the next four years. We commend it to them for study.

Roanoke Rapids In Review

One of the most important cases in the federal versus private power fight comes up again before the U. S. Court of Appeals next week. Department of Interior officials are intent upon winning this strategic engagement. For herein lies their future ambition to develop all of the rivers in the country.

To gain this end they have made every conceivable claim to support their case. They have even gone to the point of questioning the engineering feasibility of the project planned by Virginia Electric & Power Co.

In Oscar L. Chapman's request to the Solicitor General for permission to file a petition in the U. S. Court of Appeals in this case, such a statement is actually made. He says in this letter:

"The issues are whether the Applicant's proposed project has engineering feasibility; also whether it has economic feasibility from the standpoint of the company and its investors, whether the proposed project is economically feasible from the standpoint of the consumers. . . . There is also involved a question as to whether the company, its investors, and the consumers would benefit by the proposed project, as compared with the benefits to be derived by them from steam plants involving the same investment as the proposed hydroelectric project."

It appears to us that the Department of Interior has long since forgotten the interests of companies, investors, and consumers. They can leave such problems to private enterprise. They and the courts can also be sure of the fact that there was no politics involved in VEPCO's decision to build a hydroelectric plant rather than a steam plant.

A Disservice to the Industry

Some of our good friends in the industry have been pretty upset because we carried an article in the July 30 issue (p82) of "Electrical World" covering a survey of salaries of electrical engineering graduates of Kansas State College. They have stated very bluntly that we have done "a disservice to the industry" by making these data public. Their reasons are that the results are not typical, that the data are far out of line with present wage scales, and that we implied that the information was applicable country-wide.

We realize that the starting salaries shown in the chart are not of today's vintage. But we presume that the comparisons are accurate. Perhaps the data are not typical of the country as a whole. But considering all sides, we feel that a serious charge has been made by publication of these comparative salary statistics. The only one who can answer this charge is the electric utility industry.

We do not ask that figures be published. But we do believe that every one responsible for his company's wage structure should make a thorough study of its own case. It would be a greater disservice to the industry if this course were not followed.

The Electrical Energy Tax Must Go

The House of Representatives has wisely seen fit to rectify one of the most obvious tax inequities of our generation. Of course, we are referring to the 3 1/3% electrical energy tax. Its first effort was to apply this tax to the electric customers who had heretofore been excluded. This idea was quickly killed by representatives of the untaxed. Now the question is up to the Senate; and if the Senators are at all fair minded, they will affirm the stand of the Representatives.

The power to tax is the power to destroy. It is inconceivable that our elected representatives should have the desire to destroy through unfair taxation one of the most important and efficiently run industries in our country. It should, therefore, be obvious to everyone that the electrical energy tax must go.

Aid For Education

Good service is a long range and all inclusive objective of electric utilities. It covers good community relations as well as continuity of the electric supply. Expenditures for education, scientific, and welfare purposes up to 5% of earnings are allowed as deductions before taxes under the present tax law. So for a cost of only 50¢ out of each dollar spent utility may contribute materially to community activities.

In a recent report of the National Planning Association, authored by Beardsley Ruml and Theodore Geiger, it is recommended that business firms make greater use of this tax loophole. The report cites several instances of smart uses of this tax advantage. Sears Roebuck & Co finances around 100 undergraduate college scholarships. The Ford Motor Co provides scholarships for children of employees. We know of some utilities who are offering scholarships, but they can be counted on one hand.

It seems that aid for education would be a fine activity to promote better community relations and to help provide the kind of employees that will be required to run the complex utility system of the future.

Conformance Speeds Delivery

Electric utilities can speed deliveries of electrical equipment orders by conforming to defense agency regulations in placing them. Manufacturers report that a "substantial" number of orders received do not bear the required DO rating or allotment symbol which they need to get materials. All such orders must necessarily be delayed.

The Electrical Week

INDUSTRY MOBILIZATION—(Pages 86 and 87) Depa directory lists personnel with room and telephone numbers . . . Utilities are asked by Depa to check fourth quarter requests for structural steel and reduce them . . . C. G. Laslie, government career man, is named chief of the Program and Requirements Branch of NPA's Electrical Equipment Division . . . Carbon Brush Section of EED is transferred to Miscellaneous Metals and Minerals Division . . . Industry M Orders are listed on Page 86 . . . The industry got more CMP materials for the fourth quarter but still needs more. The copper in part came from the stockpile . . . NPA is checking on violators of CMP regulations . . . In labor-scarce areas military personnel may work part time for private industries under certain conditions.

WASHINGTON—Interior Appropriations Bill goes to the President after conferees agree on amendments (p 80) . . . Army Engineers Corps is criticized by House appropriations subcommittee for making unreliable cost estimates on its projects (p 81) . . . Labor Department releases blueprint to ease the shortage of engineers (p 83).

ELSEWHERE—BPA announces it will cut off interruptible power to nine electrolytic industries this winter unless unusually good water conditions prevail (p 82) . . . Consolidated Edison Co of New York is charged with smoke violations by the city (p 83) . . . Detroit Edison Co aids ECA program by training Italian plant operators (p 84) . . . Securities Exchange Commission denies charges of favoritism in not forcing United Corp to dissolve under 1935 Holding Company Act (p 88).

Comment on "Farm Electrification Week," by VP Alben Barkley: "Maybe the power companies are celebrating the near completion of the cream-skimming operations."

Sen James H. Duff (R-Pa.) accuses General Electric of dealing in nickel black market. Reason: A GE official testified the company paid $4.50 a lb for metal listed at 70¢.

When second unit for California Electric Power Co's 60,000-kw Highgrove outdoor station goes on line in 1952, there will be but one operating crewman per 5 Mw of capacity (around-the-clock basis). Thus use of manpower is as efficient as in some 100 Mw and above plants.

Atlantic City Electric will serve entire requirements for electricity (12,500 kw), steam, and hot water of Du Pont's Dacron plant in central New Jersey.

ECAP's radio show, "Meet Corliss Archer," returns to the air Sunday night, Sept. 2, over CBS.

A second record high for 1951 output was set in week ended Aug. 18 with total of 7,164,469,000 kwhr.

Appalachian Electric Power Co expects to have its overhead distribution lines in downtown Roanoke underground by the end of this year.

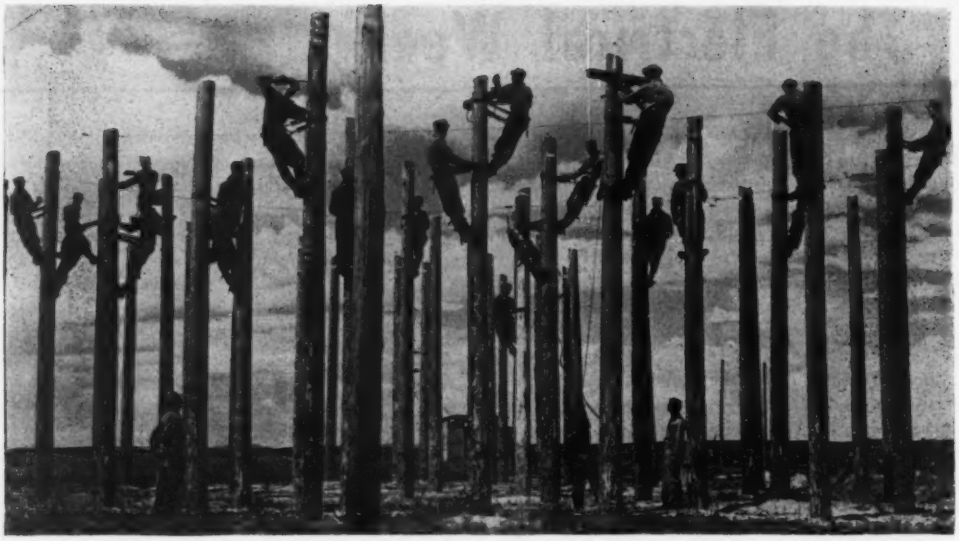
Office of Price Stabilization enters its ninth protest on rate increases. This time in brief filed with California Public Utilities Commission OPS says California Electric Power Co has failed to make a case and hike would be a "long step" toward inflation.

Adequate lighting of 4,000 small private airports for night flying (3-4 kw) would boost business. There would be more night flying, more private planes would be sold, airport operators would get more business, and utilities would get a desirable night load, EW's Bob Blatt told The National Technical Conference of The Illuminating Engineering Society.

Despite investigation by House members showing that Army engineers consistently underestimate costs of their projects, Senator Lehman (D-Lib, N. Y.) still advocates the Corps build the Niagara Falls power plants and quotes their cost figures.

TVA is signing pooling agreements with groups of private companies to get power to supply AEC installations until TVA's capacity is boosted.

Congratulations—Wage Stabilization Board names VP's H. K. Breckenridge, West Penn Power, to Philadelphia regional board; Adam Bennion, Utah Power & Light, to Denver board; and L. E. Karrer, Puget Sound Power & Light, to Seattle Board . . . Bangor (Me.) Hydroelectric elects Edward M. Graham, Jr, vice president. He is son of its president and grandson of former president, the late John R. Graham . . . Dr Paul D. Saunders, editor of "The Southern Planter," named to governing board of National Farm Electrification Conference to represent National Grange . . . Arizona-born Frank A. Waring nominated as a TVA director.



AIR FORCE LINEMEN take to the wide blue yonder without planes at this training school at Francis E. Warren Base in Wyoming. Stubby poles last just about as long as the students' one-month special course before being spiked into matchwood

Interior Bill Is Sent to the President; Amendment Nicks Reclamation Fund

Congress has approved an amendment to the Interior appropriations bill taking a slight nip out of the Bureau of Reclamation's authority to build transmission lines.

The amended bill was then sent to the President.

As finally approved by both Houses, the amendment would permit the bureau to build lines only after the Secretary of the Interior found private utilities in the area "unwilling and unable" to enter into wheeling agreements to serve government power to preferred customers.

A much more strict amendment approved by the House was rejected by the conference committee. Interior is still not sure of the effect of the amendment. For instance, it is not clear whether the Secretary will have to submit a written finding to Congress to support any action he may take in this regard.

As a part of the conference report, the lawmakers renewed their request to Sec Oscar L. Chapman for an immediate report on the Bonneville-Central Valley tie line, for which funds have been prohibited. The report, adopted by both houses, said it was understood work was continuing on this line in the face of Congressional demands that it be stopped.

Other items in the bill included:

1. Limitation on Southwestern Power Administration's continuing fund for purchase of power and leasing of transmission lines.

2. Funds for construction of a transmission line from Clark Hill Dam to Greenwood, S. C.

3. Elimination of the American Falls Power Division of the Minidoka Project.

Capacity 72.2 Million KW

Capacity of U. S. central stations on July 1 was 72,292,274 kw, the Federal Power Commission has reported. Steam capacity was 51,916,475 kw; internal combustion, 1,943,068 kw; hydro, 18,432,731 kw.

Mediators Keep Trying to Avert Copper Strike

With an eye on today's (Aug. 27) strike deadline in the copper mining industry, government mediators last week continued their efforts to avoid a work stoppage which would affect 90% of domestic copper production.

Meanwhile the Wage Stabilization Board had before it proposals for settling the dispute between CIO United Steel Workers and the American Smelting & Refining Co which caused the July strike at the Garfield, Utah, smelter. Both the union and the company have submitted briefs. Main issue in both cases is wages.

•

Oppose Arkansas Plant

Four Arkansas utilities who oppose the construction of a $10.5 million steam power plant by Arkansas Electric Co-operative Corp in the northwest section of the state have asked the Arkansas Public Service Commission to schedule an immediate rehearing of its recent order authorizing the project (EW, Aug. 20, p 13). The utilities are Arkansas Power & Light Co, Southwestern Gas & Electric Co, Arkansas-Missouri Power Co, and Oklahoma Gas & Electric Co.

Army Engineers Corps Is Criticized for Making Unreliable Cost Estimates

Congress' pet agency—the Army Corps of Engineers—was seriously criticized by a House appropriations subcommittee last week.

The group charged Congress has been deprived of reliable cost and economic information on huge rivers, harbors, and flood control projects because the engineers had failed to carry out their tasks. It blamed "inadequate engineering, planning, and estimating on the part of the Corps of Engineers" for lack of accurate data on which to base action.

Urges Cutback in Functions

For one thing, the House group said, the corps is trying to do too many jobs at one time. To remedy this, it suggested civil functions be cut back while the engineers are engaged on huge defense projects.

In a report submitted to the full Appropriations Committee, the House group said, "A private owner could not tolerate such lack of engineering reliability without inviting bankruptcy. The conclusion is inescapable that the corps' planning for these projects, before construction was started, was inadequate, and that taxpayers have been paying the price ever since, year by year."

Costs Up 124%

Taking the 182 projects under construction as a sample, the group said costs are running about 124% above the original estimates. Cost estimate at the time of authorization of these projects was $2,638,517,000 and actual cost for the present fiscal year is $5,912,451,000.

On the Fort Peck Dam in Montana, which includes a power plant, the subcommittee said the cost estimate had risen from $84 million in 1935 to $156 million in 1951. It charged 37% of this increase could be laid to unforeseen conditions, engineering modifications, and inadequacies. Some $15 million of the increase was charged to the latter two causes.

To remedy the situation, the subcommittee recommended broad changes in corps practices and sought to write them into a pending supplemental appropriation bill. Among the recommendations:

1. Submit a reliable planning report to Congress in asking for construction funds for each project, including those now under construction.
2. Keep such reports up to date, year by year, for Congressional inspection.
3. Expedite issuance of a corps manual setting forth procedure for handling civil projects.

Financial practices of the corps also came under criticism, but the subcommittee said it had now set up a system of independent auditing on corps spending.

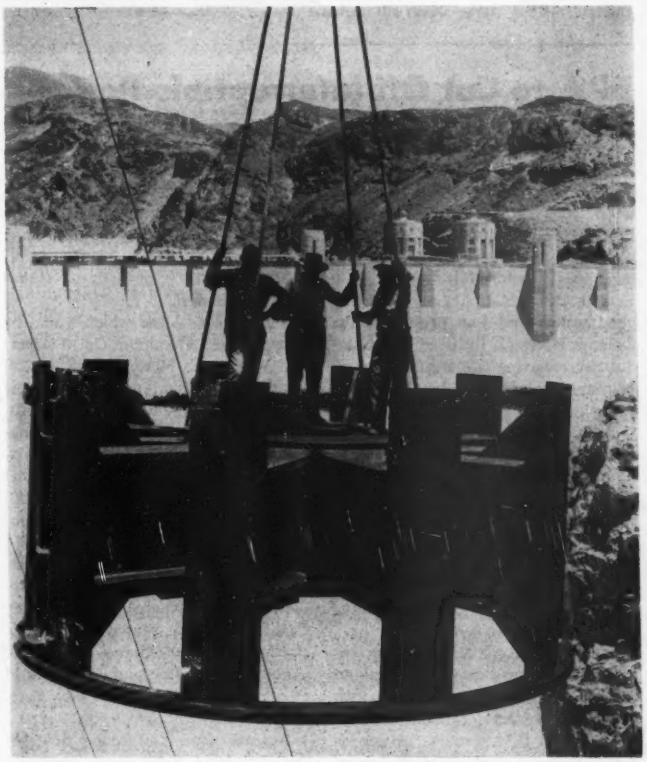
Oklahoma Would Build Markham's Ferry Dam

An Oklahoma state agency proposed to take over construction of the Markham's Ferry Dam and Power Project from the Army Corps of Engineers last week at a Senate Public Works Committee hearing.

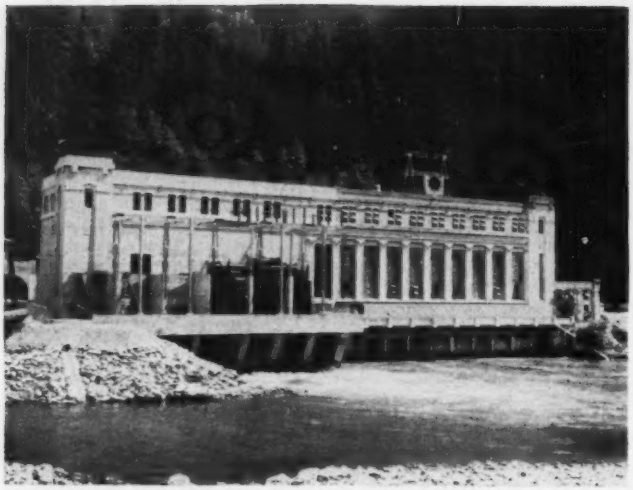
No opposition witnesses appeared, but some committee members have indicated they believe this should be a federal project.

Under the state plan, it would be built and operated by the Grand River Dam Authority, which now operates the Pensacola Project in Oklahoma. The state asked $7 million in federal funds toward construction of the $33 million project.

Army Engineers have already spent about $250,000 on surveys and planning. The state plan would conform to the Engineers' plan.



'SPIDER' for 82,500-kw unit in the Arizona wing of Hoover Dam Power Plant was recently lowered to the bottom of Black Canyon for installation. The 14-ft rotor piece was supplied by Allis-Chalmers Manufacturing Co. W. F. Wolters (center), company representative, and two workmen rode the spider down the cableway



NEW TRANSFORMER BANK in front of Seattle City Light's Gorge Plant made it possible to place new 60,000-kw generator on the line there. Three more transformers will be installed in cubicles at the left, one for each of old generators. Construction of Gorge Dam will increase output of four units to 153,000 kw

BPA to Cut Off Interruptible Power to 9 Industries Unless Water Rises

Nine major electrolytic industries have been notified by Bonneville Power Administration that interruptible loads totaling 314,000 kw will have to be dropped from Oct. 1 to Feb. 1 this winter unless unusually good water conditions prevail on the Columbia River. Included in the industries receiving this warning are all aluminum plants in the Northwest area.

Administrator Paul J. Raver explained these loads would have to be dropped to protect the rest of the region against cutbacks. He described prospects of better than normal flows on the Columbia as "fairly remote." The warning, he said, will enable industries to arrange for steam or imports of other power to continue operations.

Cutoff date for interruptible power from federal projects would be about Oct. 1 if normal flow prevails, with resumption of service about Feb. 1, or if critical flow prevails, as late as April. Between those dates all federal generation would be required to meet firm power commitments.

Raver said the curtailment would be a serious blow to the defense effort, as the interruptible power being supplied to the three major Pacific Northwest aluminum plants represents about 11% of national aluminum production.

Interruptible loads which would be dropped are: Aluminum Co of America, Vancouver, Wash., plant, 42,200 kw; Kaiser Aluminum & Chemical Corp, Spokane and Tacoma plants. 118,900; Reynolds Metals Co, Longview, Wash., and Troutdale, Ore., plants, 36,300; Victor Chemical Works, Silver Bow, Mont., 25,000; General Service Administration, Spokane magnesium plant, 47,000; Keokuk Electro-Metals Co, Wenatchee, Wash., 21,900; The Carborundum Co, Vancouver, Wash., 1,200; Pennsylvania Salt Manufacturing Co, Portland, 10,400; Union Carbide & Carbon Corp, Portland, 8,500; and Pacific Carbide & Alloys Co, Portland, 2,600.

Records show that winter flows of the Columbia have been unusually good in only four years of the last 21. Flows were in the normal range 12 years and poor to critical in five.

Cloud Seeding Studied to Increase NW Runoff

Bonneville Power Administration is conducting a survey of cloud seeding possibilities to maintain Pacific Northwest power plant reservoirs.

Bonneville has signed a $7,500 contract with Water Resources Development Corp, Denver, which will make investigations during August and September. If artificial rainmaking is found to be feasible, operations will be scheduled to increase runoff from September through March.

The contract calls for finding out whether it would be economically and physically possible to increase Columbia River runoff substantially during the seven critical storage months. The survey will cover Pend Oreille, Clark Fork, and Flathead River drainage basins of the upper Columbia south of the Canadian border.

"If winter flow of the Columbia River at Grand Coulee Dam can be maintained at average or better, power resources of about 360,000 kw could be added," Bonneville Administrator Paul J. Raver said recently. "This gain would represent about two-thirds of the total generation at Bonneville dam." Low water conditions on the Columbia during the coming winter could result in a large power deficit, Raver said.

FPC Legal Staff Backs License for Pelton Dam

Members of the Federal Power Commission legal staff have recommended that a federal license be granted for construction of the Pelton Dam on the Deschutes River in Oregon, despite strong opposition by fishing interests.

The application for license is now before FPC Examiner William J. Costello, who turned down a similar project on the Cowlitz River on grounds it might injure the fishery resources of the river. In the earlier cases, the legal staff had also recommended that a license be granted.

Attorney John C. Mason signed the brief in the Pelton Dam case. In the brief, he said the proposed project would produce "a valuable addition to the power supply of the Pacific Northwest" and was adapted to the overall plan for developing the Deschutes.

NETWORK ANALYZER was installed recently by engineers of Pacific Power & Light Co to solve problems before they crop up. Instrument permits them to reproduce the network in miniature and simulate short circuit troubles that might result from lightning, trees falling over lines, and other disturbances

Con Edison Is Charged with Smoke Violations

Consolidated Edison Co, nation's largest electric utility and New York City's largest single user of fuel, will be required to appear shortly in Magistrate's Court to answer charges of violating the city's smoke ordinance.

William G. Christy, director of the city's Bureau of Smoke Control, told "Electrical World" last week he intended to issue summonses to the utility as soon as four bureau inspectors had completed observations at Con Ed's Hellgate and Hudson Avenue plants.

"They've been observing the plants for two weeks, now," he commented. "We want to be sure of our case before we go ahead on it."

The bureau's action stemmed from a demand by Acting Council President Joseph T. Sharkey last March that the agency "crack down" on violators of smoke regulations. Con Ed was singled out by "The World Telegram and Sun" and later by the Board of Smoke Control, policy-making body for the bureau, as a major offender.

In response to a violation notice, the utility appeared before the board Aug. 7 to explain its plans for gradual reduction of smoke from its plants. Representatives said a total of $24 million will have been spent on the problem by 1955. They denied the company was a chief contributor to the smoke nuisance.

Two days later the board decided in executive session to take the matter into the courts.

A Con Ed spokesman said the company had no comment at this time on the bureau's action.

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Harrison Gets ICI Post

Dr Ward Harrison, retired chief engineer of General Electric Co's Lamp Division has been elected president and C. A. Atherton, supervisor of lamp manufacturing for Westinghouse International Co, honorary secretary, of the International Commission in Illumination. They will serve until the next session is held in 1955 in Switzerland. They were elected at a recent session held at Stockholm, Sweden.

Engineer Supply Plan Drawn by Labor Dept

The government's blueprint to ease the shortage of engineers by making better use of those we have and training new ones has been released by Secretary of Labor Maurice J. Tobin.

It was drawn by the Labor Department with help from the government's defense agencies and private organizations. Called "National Program to Meet Shortage of Engineering Personnel," it is divided into two parts: (1) What industry can do to help and (2) What the government and others have done.

Puts Job Up to Industry

Tobin feels industry should assume responsibility for making the most possible use of engineers at their highest skills, insuring adequate pay so engineers will not turn to other work, and making it easier for engineers in less essential activities to shift to work more directly related to defense.

Federal agencies and the military have been asked to follow the same line of thinking. In addition, the U. S. Office of Education has made plans to reactivate the Engineering, Science, Management War Training Program of World War II for intensive, short-term college courses.

Local draft boards have been urged, in Selective Service Occupational Bulletin No. 42, Aug. 2, to consider deferment of engineers.

The Engineering Manpower Commission of the Engineer's Joint Council has embarked on a program to encourage more high school students to enter engineering colleges and to promote better use of engineers.

NEMA Forms Committee

A "Committee on Engineering Talent" has been formed by the National Electric Manufacturers Association to study the critical shortage of engineers in the manufacturing industry and make recommendations to the NEMA board of governors. Chairman is F. H. Roby, vice president, Square D Co.

The board wants the committee to analyze the engineer-recruiting situation that faces the industry during the next ten years, to recommend what steps should be taken to attract graduates to the industry, and estimate cost of the program recommended.

Detroit Edison Aids ECA Program by Training Italian Plant Operators

International cooperation has been given a practical workout at Detroit Edison's Conners Creek Plant. Three power plant operators from Italy recently completed intensive training there in the use of modern American steam-electric generating equipment.

The three men, Marino Cerrato, Giuseppe Vastarella, and Pietro Iodice, are employees of the Societa Meridionale di Elettrica, Naples. They came to this country as students in a "technical assistance" program financed by the U. S. Economic Cooperation Administration.

Reason for the program: Power-short Italy soon will have a number of modern steam-electric turbine generators furnished through European Recovery Program funds. And men must be taught to run them.

Training of the men was worked out by Walker L. Cisler, Detroit Edison executive vice president and ECA chief power consultant. He served as an adviser in setting up the overall technical assistance program, which calls for training of 26 employees from seven Italian utilities. The program was originally proposed by Italy's Associazione Nazionale Imprese Distributrici Energia Elettrica.

Italian coordinator for the training is Mario Piccagli, 32-year-old electrical engineer from Milan. The association appointed A. E. Grunert, ECA consultant and former steam station superintendent for Commonwealth Edison, Chicago, as American coordinator.

Piccagli explains the program as follows:

Until World War II, more than 90% of all power development in Italy was hydroelectric. During the war construction of power plants was stopped, and damage and deterioration were heavy. Low rainfall later aggravated an already severe electric power shortage. Steam-electric plants, totaling about 1 million kw, have been financed by the European Recovery Program and purchased from American manufacturers.

But this did not solve the problem. Few Italian plant operators knew much about thermal plants. Those who did were familiar only with obsolete equipment. The seven power companies receiving equipment and construction loans from ERP were granted permission to send trainees to the United States.

Other companies that have so far assisted in the training program are Commonwealth Edison Co., Chicago; Dayton Power & Light Co.; Bailey Meter Co., Cleveland; and United Illuminating Co., New Haven.

Trainees are being sent from each Italian company so that they can complete their six-months training before its construction program begins. They are expected to assist in construction work.

Age of Progress

What happens when your electricity fails? This was the question asked by Gertz Department Store at Jamaica, N. Y., in a recent 34-col in. ad in "The New York Times." Gertz suggested a kerosene lamp at $2.49. "Every home," the copywriter commented, "can use 3 to 6."

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Paring of U. S. Payroll Cuts Service to Industry

Curtailment of services affecting the electric power industry was predicted last week as a result of Congress' policy to pare the government payroll.

A spokesman for the Federal Power Commission said the personnel cutback in the agency would, no doubt, further delay the licensing of interstate electric and natural gas projects. He forecast growing backlogs of applications for rate increases, especially those not directly affecting the defense effort. FPC has already reduced its personnel by not filling vacancies, and intends to continue this policy.

A Security and Exchange Commission spokesman said it would have to send out separation notices to some of its employees to carry out the 10% cut ordered by Congress. It plans to have only 925 persons on the payroll by mid-September, compared with a July 1 force of 1,028. It has already cut its field office in San Francisco so that all applications for new financing approvals must be handled in Washington.

Rural Electrification Administration may have to send out more separation notices in addition to the 49 it has already given employees of its engineering and loan staffs. However, Congress provided funds for loans to electric cooperatives, with an additional $75 million in case the regular appropriation falls short.

Bonneville, Southeastern and Southwestern Power Administrations, and the Bureau of Reclamation will also be hit by the personnel reductions.

BATON ROUGE LIGHTNING is a respecter of utility property. True, it did hit the pole, but it left the lamp intact

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Foreign Branch Planned

Plans for the establishment of a European branch early next year have been announced by Battelle Memorial Institute, the world's largest independent industrial research foundation. Dr Clyde Williams, director, said the exact location will depend upon negotiations now pending.

1951 Output Guesstimate Tops 369 Billion Kwhr

If you are wondering how many kilowatt hours of electric energy the nation's central stations will produce this year, quit wondering. The total will be 369,067,000,000 kwhr, 12.179% more than in 1950.

How can "Electrical World" be so sure of this estimate? It is the average of 272 guessers in Bob Hatfield's annual "guessing contest."

The contest this year drew entries from 88 utilities (both public and private), numerous manufacturing firms, consulting engineering firms, and government bureaus. Presidents of 24 investor-owned utilities sent in entries, and their guesses were not all in accord with those of the "load experts" of their companies. Eleven "girls" are entered.

The winning figure will be that carried in EW's Statistical Issue next January.

Hatfield has been conducting these contests since 1946. He is employed by Combustion Engineering-Superheater, Inc, at Los Angeles. At present he is connected with the Munitions Board at Washington.

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British Columbia Utility Contemplates Expansion

British Columbia Electric Co may expand its Bridge River Hydro-Electric Plant soon to meet continuing increases in power demands in the Greater Vancouver-B. C. Lower Mainland area. Although the company has not yet officially announced plans for expansion, it is reported preparations are under way for installation of more units.

The BCE power station on Seton Lake currently develops 186,000 hp from its three units, but it is designed to produce 620,000 hp at a ten-unit capacity.

Indications are now that the Greater Vancouver area will require 250,000 to 260,000 more hp by 1955 than BCE now has built or is building. To meet the additional requirement, five new units would be called for at Bridge River. Increases in power demands in the next few months probably will decide the date for start of installation and whether five or seven new units are necessary to complete the project.

Present BCE plans call for an expenditure of $100 million over the next five-year period. Of this, $10 million will be used by the company's new Jones (Wahleach) Lake Plant and transmission line at the head of the Fraser Valley, while additional work at its Lake Bunzten Plant will take $3.5 million more. Jones Lake will provide an additional 80,000 hp and Bunzten, 70,000 hp.

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3 Added to LCRA Board; 3 Present Members Stay

Three new members have been appointed and three members have been reappointed to the board of directors of the Lower Colorado River Authority. The new members appointed are Bower Crider, M. C. Dalchau, and R. H. Parker. Those reappointed are R. D. Corder, Sam H. Seymour Jr, and R. D. Wright. The reappointments were for six-year terms.

Appointments were made by Governor Allan Shivers. Membership of the board was increased under a law passed recently by the Texas state legislature. Terms of the new board members will expire on Jan. 1 of the following years: Parker, 1953; Crider, 1955; and Dalchau, 1957. Thereafter members will serve six years.

Heat Pumps Not Feasible for Seattle, Study Shows

Heating of homes with heat pumps is not generally feasible in the Puget Sound area of western Washington state around Seattle, Prof George S. Smith of the University of Washington Electrical Engineering Department has concluded after thorough investigation. The examination was sponsored jointly by the university's Experiment Station and Bonneville Power Administration.

One factor that limits widespread use of heat pumps, Smith found, is that the average city lot is too small. Heat extracted from the ground in winter must be restored by the sun's rays each summer, if the heat pump is to continue functioning. The ground area not covered by the dwelling just isn't large enough to permit this restoration in the average case.

Puget Sound soils, usually clay or peat, are poor conductors of heat, the investigation discovered.

A homeowner with a well or an underground spring on his property would find the heat pump "a very economical means of heating after the first cost of installation has been cared for," Smith found. Lake or stream water is less satisfactory as a source of heat but can be used.

SOUTHEASTERN ELECTRIC EXCHANGE

Section and Committee Chairmen, July 1, 1951-June 30, 1952

Section or Committee	Chairmen
Accounting Section	R. B. Carpenter, treasurer, Carolina Power & Light Co, Raleigh, N. C.
Engineering & Operation Section	W. T. Hess, vice president, Louisiana Power & Light Co, New Orleans, La.
Distribution Committee	J. B. Coltharp, superintendent, Transmission & Distribution Department, Gulf States Utilities Co, Baton Rouge, La.
Production Committee	A. J. Skaale, superintendent of Power, Carolina Power & Light Co, Raleigh, N. C.
Transmission & Large Substations Committee	J. A. Rawls, supervisor Electrical Equipment & Transmission, Virginia Electric & Power Co, Richmond, Va.
Bushing Standardization Committee	T. J. Allen, superintendent, Transmission, Georgia Power Co, Atlanta, Ga.
Personnel Administration Section	Arthur M. Williams, Jr, staff counsel, South Carolina Electric & Gas Co, Columbia, S. C.
Power Coordination Committee	H. J. Scholz, president, Southern Services, Inc, Birmingham, Ala.
Sales Section	S. L. Drumm, vice president, New Orleans Public Service Inc, New Orleans, La.
Advertising Committee	J. K. Flanagan, director of Advertising & Publicity, Florida Power Corp, St. Petersburg, Fla.
Agricultural Development Committee	J. R. Lester, manager Rural & Towns Division, Alabama Power Co, Birmingham, Ala.
Commercial Sales Committee	W. M. McPherson, commercial sales manager, Carolina Power & Light Co, Raleigh, N. C.
Industrial Power Committee	B. D. Painter, division commercial manager, Appalachian Electric Power Co, Bluefield, W. Va.
Residential & Rural Sales Committee	J. H. Keele, sales promotion manager, Florida Power & Light Co, Miami, Fla.
Heat Pump Steering Committee	E. C. Easter, vice president, Alabama Power Co, Birmingham, Ala.
Accident Prevention Committee	E. C. Bookman, safety director, Virginia Electric & Power Co, Richmond, Va.

Defense Electric Power Administration

(Prepared by "Electrical World"—Aug. 10, 1951)

Office of the Administrator
Administrator—James F. Fairman (5459-X664)
Deputy Administrator—Kenneth G. Whitaker (5459-X5237)
Special Assistant—Francis A. Kolb (5458-X2553)
Staff Assistant—John C. Evans (5456-X647)

Office of Consultant Staff
J. E. Moore (5449-X3611) T. F. Treadway (5446-X647)
Constantine Bary (4460-X3227)

Office of General Counsel—E. Jason Dryer (5451-X2698)

Office of Information—George S. Holmes (5443-X3222)

Power Supply Division—Director, Robert Brandt (5446-X621)
Power Requirements Branch—Clifford Beardsley (4460-X3227)
Power Coordination and Planning Branch—Vacant (5452-X621)

Materials and Equipment Division—Director, T. E. Marburger (5450-X621)
Major Projects Control Branch
Clinton Hurd (5254-X4451)
Charles Cornforth (2444-X5385)
Minor Requirements Branch
B. B. Parker (4458-X2947)
Archie L. Sills (4456-X2664)
Major Equipment Scheduling Branch
Richard Grant (4457-X2729)
Louis J. Workman
Construction Expediting Branch
A. G. Skina (4062-X5327)
Statistics and Procedures Branch
B. S. Leob (4542-X5165)
Joseph Epstein (4540-X5165)
Paul Hand (4544-X5165)

Administrative Management Division—Director, Fred W. Bolen (5447-X5239)
Personnel Branch—Myron E. Hoft (5447-X2480)
Programs and Finance Branch—Charles Winter (5444-X5377)
General Services Branch—George Gauzza (5056-X4471)

All offices are in the Department of Interior Building, C Street between 18th and 19th Sts. N. W., Washington 25, D. C. Telephone extensions are on Republic 1820. Numbers with each name are room and phone extensions.

Utilities Asked to Check 4th Q Structural Requests

Electric utilities have been asked to reexamine their fourth quarter requests for structural steel and bring them more nearly in line with available allotments.

Defense Electric Power Administration urged that particular attention be paid to requests for such material for steel towers. Under CMP an average of only 60% of a tower is classified as structural shapes. The balance is classified as bar.

CMP definition of structural is "shapes having one or more cross section dimensions of 3 in. or over." Bar includes light structural shapes.

In cases where fourth quarter allotments have not been received, it is asked that requests be amended to conform to CMP definitions.

Where allotments have already been processed, utilities are asked to call any corrections to the following persons at Depa headquarters in Washington:

General projects—Arnold A Boettcher, X4451.

Transmission projects—Merle E. Sutton, X5385.

Distribution projects — Clarence Hartay, X5385.

The numbers are extensions to the Interior Department switchboard which may be reached by calling REpublic 1820.

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NPA Section Transferred

The Carbon Brush Section of Electrical Equipment Division will be shifted to the Miscellaneous Metals and Minerals Division of National Production Authority.

Government Man Named New Chief of NPA Branch

C. G. Laslie, a government career employee, is new chief of the Program and Requirements Branch of National Production Authority's Electrical Equipment Division.

He succeeds R. H. St. John, who died at Emergency Hospital in Washington Aug. 16 following a heart seizure suffered two weeks earlier while at his job.

The new branch chief is an alumnus of the Electrical Materials Section of World War II's War Production Board. He has since served under the Army Department in Japan, where he was with the Industry Division of SCAP supervising Japanese electric utilities. He also served more than two years as director of commerce and industry at Ryukyu Island.

St. John came to EED in November of last year from his own business concern in Albany, N. Y. He had previously been connected with Westinghouse Electric Corp.

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Industry M Orders

The following M Orders and amendments of interest to the electrical industry have been issued by the National Production Authority. Orders not of interest have been omitted. Copies may be secured from the National Production Authority, Washington 25, D. C., or any regional office of the Department of Commerce.

M-80—Ferro-alloys and ferro-alloy products: Completely allocates cobalt, columbium, tantalum, molybdenum, nickel, and tungsten. Brings under centralized control boron, calcium, chromium, manganese, silicon, titanium, vanadium, and zirconium.

M-81—Tungsten and molybdenum: Permits delivery only in accordance with an allocation authorization issued by NPA. Also limits inventories to 60-day requirements.

Amendments to Previous Orders

Amendment to M-48 increases permitted use of **bismuth metal or alloys** in any month from 60% to 100% of average monthly use during the first six months of 1950, or 100 lb, whichever is greater. Also increases permitted inventories to a 45-day supply.

Industry Gets More CMP Metals for 4th Quarter, Still Needs More

Readjustments have been made in fourth quarter controlled material allotments for the electric power industry. But the changes still are far short of actual requirements.

Biggest changes were made in allotments for the Electrical Equipment Division of the National Production Authority. The readjustments, however, will enable it to fill only 70% of a fourth quarter request which had been cut below practical needs.

This division received an increase of 6.3 million lb of copper foundry products over its original allotment of 5.8 million lb. It also received an increase of 1,480,000 lb of stainless steel to bring it up to the flat 70% of the reduced request. However, the division had to take a cut of more than 30,000 tons of steel—alloy and carbon—in the readjustment of its metal allotments.

Defense Electric Power Administration received an increase of 15,000 tons of structural steel to bring its fourth quarter allotment up to 120,000 tons. It had originally requested 137,000 tons.

NPA's Engine and Turbine Division received an increase of more than 2.1 million lb of copper foundry products. Much of this increase will go for water conditioners. EED also received permission to raise its structural steel allotment ceiling by 2,200 tons at the expense of other types of steel in its original allotment. Most of the structural steel increase will be used for boiler construction.

Bonnell W. Clark, chief of EED, won his battle for a more balanced approach to the allotment problems of his division. He figures the division will now be able to process allotments to manufacturers "realistically if inadequately." Next step will be to ask for a general increase in all types of controlled metals needed by his division in an effort to get an increase above the 70%-of-minimum level now allotted for the fourth quarter.

Prospect now is the EED will be worse off in the fourth quarter than at present. While metal allotments for the next quarter are above original third quarter allotments, they are 30% short of the final third quarter allotments, which included some materials for new product codes assigned to the division.

"Unless some changes are made," Clark commented, "power stations will be up without the necessary auxiliaries — without the transformer banks and switchgear needed."

Off the Stockpile

Some of the copper in increased fourth quarter allotments came from the nation's strategic materials stockpile. Officials released 25,000 tons to fill the gap caused by the July strike at Garfield, Utah, smelter. This cut output an estimated 24,000 tons.

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CMP Investigation Starts

National Production Authority investigators have begun checking 1,000 companies in a special study of CMP compliance. They are looking for evidence that authorized production schedules are being exceeded, that orders for materials exceed allotments, or that inventories are high.

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To Ease Labor Shortage

Military personnel may be a source of part-time workers if your area is one of labor shortage. Authority must be given, however, by local military commanders, and the outside work must not interfere with regular military duties. The practice, followed in World War II, has been approved by the Department of Defense.

Libby Project Planning Slows Canada Highway

Proposals for the 200,000-kw Libby Dam power project in Montana have brought about suspension of work on the 200-mile Big Bend portion of the Trans-Canada Highway in British Columbia.

Works Minister E. C. Carson said no further work will be done on the road while plans are in the air for the project. Go-ahead on the hydro scheme would force abandonment of a large part of the highway, and a totally new route would be required between Golden and Revelstoke.

Building of Libby Dam will back up waters of the Columbia River north of Revelstoke, flooding some 17,000 acres and inundating parts of the present highway.

British Columbia has been asking the United States for a share in the hydro output from Libby as compensation for flooding of lands, and the question is reportedly far from settled. (EW, Aug. 6, p 14.)

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Damages Laid to Utility Noises Are Disallowed

Appellate Court in Indiana recently handed down a decision expected to have far-reaching effect on future expansion and operation of the state's municipally-owned utilities.

The court held a municipal utility has power to increase its capacity and other facilities even though such expansion causes damage or inconvenience to those residing near it. The ruling held that only when it can be shown that damage due to utility expansion was caused by negligence in operation of such plant can owners of nearby property collect.

The decision came in the suit brought by H. R. and Fern Robinette against the Board of Trustees of South Whitley, Ind. The plaintiffs live across the street from the municipal power plant, and sought damages because a heavy Diesel engine was installed in the plant, causing noise and vibration in their home.

A jury in a lower court awarded the Robinettes damages of $3,391 against the town, but the Appellate Court set aside this finding.

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Commissioners Re-elected

Chairman Matt L. McWhorter and Vice Chairman Perry T. Knight have been re-elected by the Georgia Public Service Commission. Both will serve for a period of two years.

YIELDS (%) — Operating Electric Utility Securities

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1951									
Aug. 16	2.88	2.93	3.07	4.05	4.24	4.61	5.50	6.20	7.01
Aug. 9	2.89	2.93	3.11	4.07	4.27	4.64	5.52	6.18	6.99
END OF QTR.									
2nd 1951	3.02	3.11	3.23	4.11	4.37	4.68	5.73	6.38	7.37
1st 1951	2.87	2.93	3.00	3.96	4.19	4.52	5.47	6.20	7.13
4th 1950	2.65	2.67	2.78	3.86	4.14	4.51	5.80	6.54	7.44
3rd 1950	2.66	2.67	2.76	3.81	4.08	4.46	5.70	6.54	7.25

Data: Reis & Chandler, Inc.

SEC Denies Charges of Favoritism in Not Forcing United Corp Breakup

The Securities and Exchange Commission last week pounced on charges that it had shown favoritism in dealing with United Corp. A utilities holding company, SEC permitted it to become an investment company.

Besides denying the charges, the commission strongly hinted that a disgruntled United minority stockholder was to blame. The stockholder is believed to be Randolph Phillips. He has appealed to the courts seven times to reverse the SEC decision of 1943 allowing United to escape dissolution by becoming an investment company.

The SEC blast followed by a few hours the submission of a report by a House Judiciary subcommittee staff recommending an investigation of the agency and its dealings with United.

This report noted that a number of former SEC employees now hold high positions with United. It also intimated that the commission had been influenced by some of these employees. William M. Hickey, a SEC staff member from November, 1934, to June, 1936, is president of United. The company also employs four other former SEC workers.

Among other things, the staff recommended that the subcommittee attempt to determine whether any favoritism was shown United in allowing it to become an investment company. Some 70 other holding companies were ordered dissolved under the Public Utility Holding Company Act of 1935.

The staff also wanted to find out whether SEC had shifted its position after Hickey was appointed president and director of United in April, 1943.

In answering these charges SEC said it was only carrying out the law and the intent of Congress in allowing United to become an investment company—that it had never ordered it liquidated or dissolved. In fact, said SEC, the 1943 decision did not set new policy since this was one of the two ways suggested by Congress for meeting problems of holding companies.

Both SEC and Richard Joyce Smith, counsel for United, have pointed out that the charge of favoritism is ill-founded. Four of the former SEC employees now serving United left the commission before any of the present commissioners was appointed. These commissioners, none of whom participated in the 1943 decision, have approved United's request to become an investment company. Last June they gave their conditional approval to a United plan to complete the change from a holding company to an investment company. Most of the changes suggested by SEC have been made.

Smith declared that had the commission ordered the dissolution of United "there would be little or no equity remaining for the common stockholders. . . . Everyone benefited by the withholding of dissolution order." He added that the corporation was allowed to remain in existence primarily because it had a good case for doing so.

FINANCIAL BRIEFS

Hawaiian Electric Co, Ltd, has sold privately $3 million in first mortgage bonds, 3½%, 1981, through Dillon Read & Co and Dean Witter & Co . . . **Pennsylvania Power & Light Co** plans to offer common stockholders on or about Sept. 18 the right to buy 542,136 shares on a 1-for-7 basis . . . **Harriman Ripley & Co** has sold quickly 18,000 shares of Columbus & Southern Ohio Electric Co common stock at $20.75.

Miami, Fla., has filed suit in circuit court seeking to regain home rule control over electric rates and to invalidate the new state law delegating this power to the Florida Railroad and Public Utilities Commision.

Electric Utility Financing

Company	Description	Amount of Offering (000)	Offering Price	Yield at Price to Public
WEEK OF AUGUST 15-22				
Common Stock				
Southern Colorado Power	30,970 sh new money	$ 279	$9.00	7.78%
SCHEDULED FOR AUGUST 22-29				
Bonds				
Southern California Edison	1st ref mtg D, 1976	$30,000		
SCHEDULED FOR LATER DATE				
Bonds			Bid Date	
Columbus & Southern Ohio Electric	1st mtg, 1981	$12,000	Sept. 5	
Alabama Power	1st mtg, 1981	15,000	Sept. 11	
New England Gas & Electric Association	coll tr, 1971	6,115	Sept. 18	
Common Stock				
Utah Power & Light	175,000 sh		Sept. 19	
UNDER CONSIDERATION				
Bonds				
Arkansas Power & Light	1st mtg	$ 8,000		
Central Illinois Light	1st mtg	6,000		
Pennsylvania Electric	1st mtg	5,000		
Rockland Light & Power	1st mtg	6,000		
Utah Power & Light	1st mtg	9,000		
West Texas Utilities	1st mtg	8,000		

Canadians Start Surveys to Determine Hydro Site

A big new hydro project may be developed in northern Alberta, with 500-sq-mi Lesser Slave Lake as its main storage basin.

Alberta Power Commission and Calgary Power, Ltd, are undertaking preliminary surveys to determine whether the lake can be used in connection with a power site at Grand Rapids on the Athabasca River 190 mi north of Edmonton.

The Grand Rapids site previously had been considered impracticable, but increased industrial development has brought about reconsideration of the project.

MEETINGS

Illuminating Engineering Society
National Technical Conference, Hotel Shoreham, Washington, D. C., August 27-30.

Northern California Electrical Bureau
Annual Exposition, Civic Auditorium, San Francisco, September 7-14.

Rocky Mountain Electrical League
Fall Convention, La Fonda Hotel, Santa Fe, N. M., September 9-12.

Edison Electric Institute
Commercial Cooking Committee, EEI Headquarters, 420 Lexington Ave., New York, September, 10-11; Prime Movers Committee, Statler Hotel, Buffalo, N. Y., October 1-2; Meter-Service Committee, Purdue University, Lafayette, Ind., October 1-3; Electrical Equipment Committee, New Ocean House, Swampscott, Mass., October 8-9; Transmission-Distribution Committee, Sheraton Hotel, Rochester, N. Y., October 10-11.

Instrument Society of America
National Instrument Conference-Exhibit, Sam Houston Coliseum, Houston, Tex., September 10-14.

Northwest Public Power Association
Joint Meeting with Montana REA Association, Hotel Florence, Missoula, Mont., September 12-14.

Michigan Municipal Utilities Association
Annual Meeting, Plankinton House, Milwaukee, Wis., September 13-14.

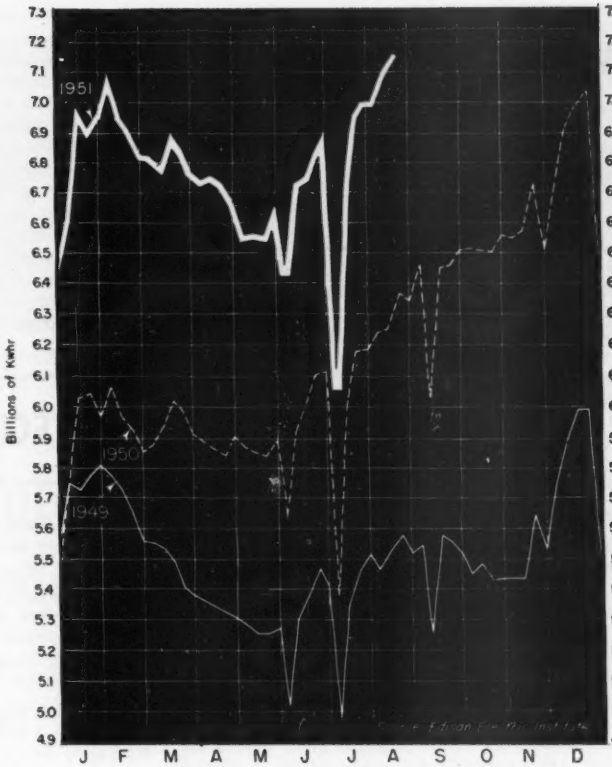
International Association of Electrical Inspectors
Southwestern Section, Hotel Lafayette, Long Beach, Calif., September 13-15; Northwestern Section, Hotel Davenport, Spokane, Wash. September 19-21; Western Section, Hotel Fontenelle, Omaha, Neb., September 25-27; Eastern Section, Hotel Claridge, Atlantic City, N. J., October 1-3; Southern Section, Hotel John Marshall, Richmond, Va., October 15-17.

Pennsylvania Electric Association
Annual Meeting, Benjamin Franklin Hotel, Philadelphia, September 18-19; Transmission-Distribution Committee, Hotel Concord, Northeast, Pa., October 11-12; Hydraulic Power Committee, Irem Temple Club, Dallas, Pa., October 11-12; Joint Relay-Communications Committee, Emerson Hotel, Baltimore, Md., October 18-19; Electrical Equipment Committee, Penn Alto Hotel, Altoona, Pa., October 22-23; Meter Committee, Arlington Hotel, Oil City, Pa., October 25-26.

Public Information Program
Annual Workshop Conference, Edgewater Beach Hotel, Chicago, September 20-21.

Wisconsin Utilities Association
Accounting Section, Plankinton House, Milwaukee, Wis., September 20-21.

Public Utilities Association of the Virginias
Annual Meeting, Greenbrier Hotel, White Sulphur Springs, W. Va., September 21-22.



Output Week Ended Aug. 18—7,164,469,000 Kwhr

Weekly Output, Millions Kwhr

1951	1950	1949
Aug. 18 7,164	Aug. 17 6,370	Aug. 16 5,579
Aug. 11 7,070	Aug. 12 6,253	Aug. 13 5,530
Aug. 4 7,003	Aug. 5 6,247	Aug. 6 5,466
July 28 7,005	July 29 6,190	July 30 5,518
July 21 6,975	July 22 6,186	July 23 5,462
July 14 6,739	July 15 6,006	July 16 5,342
July 7 6,077	July 8 5,380	July 9 4,982
June 30 6,898	July 1 6,115	July 2 5,410
June 23 6,835	June 24 6,102	June 25 5,466
June 16 6,747	June 17 6,012	June 18 5,373

Percent Change from Previous Year

	Aug. 18	Aug. 11	Aug. 4
New England	+ 5.0	+ 4.5	+ 4.3
Mid-Atlantic	+13.0	+12.5	+ 9.3
Central Industrial	+ 8.4	+ 9.2	+ 8.5
West Central	+ 9.8	+13.3	+15.0
Southeast	+12.2	+12.7	+12.0
South Central	+29.3	+33.4	+26.9
Rocky Mountain	+ 8.6	+ 8.1	+11.5
Pacific Coast	+14.7	+14.2	+15.6
Total United States	+12.5	+13.1	+12.1

American Society of Mechanical Engineers
Fall Meeting, Hotel Radisson, Minneapolis, Minn., September 25-28.

Iowa Utilities Association
Management Conference, Fort Des Moines Hotel, Des Moines, Iowa, October 1-2.

Southeastern Electric Exchange
Engineering-Operation Section Conference, John Marshall Hotel, Richmond, Va., October 4-5; Sales Conference, Roosevelt Hotel, New Orleans, La., October 31, November 1-2.

National Farm Electrification Conference
Annual Meeting, Hotel Gibson, Cincinnati, October 9-10.

National Electrical Contractors Association
Annual Convention, Shoreham Hotel, Washington, D. C., October 9-12.

Indiana Electric Association
Annual Convention, French Lick Springs Hotel, French Lick, Ind., October 10-12.

International Association of Electrical Leagues
Annual Conference, Roosevelt Hotel, New Orleans, October 10-13.

Association of Edison Illuminating Companies
Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va., October 11-13.

National Association of Railroad and Utilities Commissioners
Francis Marion Hotel, Charleston, S. C., October 16-19.

Public Utilities Advertising Association
Hotel Cleveland, Cleveland, Ohio, October 18-19.

National Association of Corrosion Engineers
South Central Region Meeting, Robert Driscoll Hotel, Corpus Christi, Tex., October 18-20.

National Electronics Conference
Annual Conference, Edgewater Beach Hotel, Chicago, October 22-24.

American Institute of Electrical Engineers
Fall General Meeting, Hotel Cleveland, Cleveland, Ohio, October 22-26.

American Standards Association
Annual Meeting, Waldrof-Astoria, New York, October 22-24.

WASHINGTON COMMENT

JESSE MOCK

"No successor has been chosen."

Time and again this sentence crops up in our stories of personnel changes in the three government control agencies dealing with electric utilities. It should be of particular concern to all men who have a say in directing the policies of utilities or electrical equipment companies.

In nearly every instance it means that some man with industry experience is needed to fill a key position with either Defense Electric Power Administration, or with one of the electrical equipment divisions of National Production Authority.

As this is being written, two key jobs in NPA's Engine and Turbine Division are going begging. These vacancies occur as officials complete their six months or year "internship" in government and resume their duties with industry.

Government Career Men Are Available

Of course, if industry men can't be found to step into positions, there are plenty of government employees waiting to take over. It makes little difference whether the career man knows a transformer from a generator if he has the necessary civil service rating.

With operating experience in the field, a man is familiar with industry methods, procedures, terminology, and needs. A brief telephone conversation may be sufficient to give him all the information he needs to size up a situation. On the other hand, the career employee would require submission of long complicated government forms in triplicate before he could initiate action.

Experience also prepares an industry man to argue intelligently his case in attempting to solve a materials problem whereas the career employee must fall back on the dull figures on the forms, having little appreciation for their real significance.

But Industry Men Are Needed

Thus it becomes apparent that if the electrical industry is to wage its battles for materials in an effective way, it must have its soldiers on the scene. While a few government career men are doing outstanding jobs in the control agencies, even they have had experience in the industry at some time.

Besides the inconveniences of the present, there is something more to be considered. These career men, like all of us, want security in their jobs. They can be counted on to do what they can to make the work permanent. The spectre of a permanent system of material and price controls, even though now only a dim shadow, should be closely watched.

The situation demands that the electric industry take a direct hand in filling these vacancies as they occur. A number of utilities, both privately and publicly owned, and equipment manufacturing concerns have set up what amount to government "internships." They keep one or two of their executives in the government agencies, replacing them every six months or a year. But it is evident that not enough men are being supplied in this manner.

While assignment of an official to a government job might be a temporary sacrifice to a utility or manufacturer, there is much to be gained. Besides having a soldier in the field, the utility or manufacturer will be giving a man an opportunity to learn more about his industry as well as about the intricacies of government procedure. He should be much better equipped to deal with material control problems when he returns to his company.

In the interest of the mobilization program, as well as its own interest, the electric industry must find replacements for the control agency positions. There should be fewer stories carrying the sentence:

"No successor has been chosen."

TECHNICAL NOTES

ARCHER E. KNOWLTON

Male high school graduates total about 600,000 per year. Only 3% go into engineering schools. It should be at least 10%.

Emergency-type alarms should be identified or even grouped separately so they will be distinguished in importance by the operators.

Wallaba poles are strong but heavy; freight charges favor the Eastern seaboard for tryout area. Greenheart poles tried along the Gulf area decayed in 2 years.

Stainless steel shows superior resistance to pitting in hydro plant application; prewelding plates of it to runner edges averts later difficult maintenance.

Engineering seniors in some colleges were reported walking around contentedly with five or more job offers in their pockets.

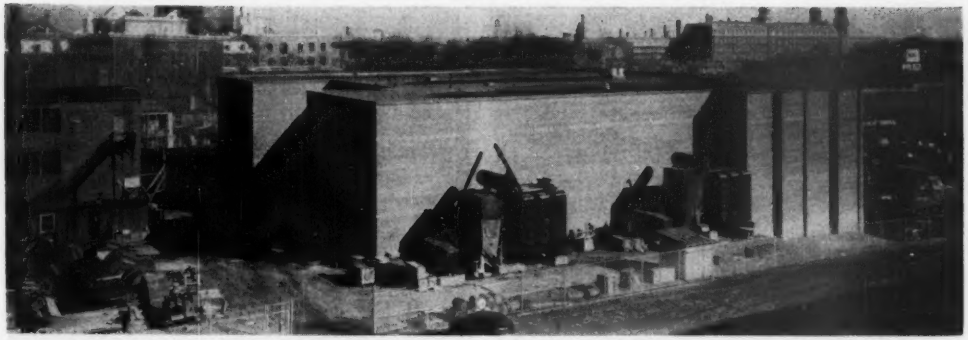
Exposed steel structures are being protected by a paint consisting of aluminum and lead pigments in a vehicle of drying oils and alkyd resin.

Pole requirements from Southern yellow pine stands are such as to need 40,000 acres of skillfully forested area to meet them.

Coal tar might be burned by steel mills for its high Btu content and thus shorten the supply of both creosote and pentachlorophenol.

Fence mesh in a third-degree stage of rust had better be replaced with fresh fabric, preferably stainless steel; painting may prove futile.

Steam should not be turned on in retractible soot blowers until the ports are past the tubes at point of entrance otherwise the blast may separate the casing.



UNIQUE INDOOR SUBSTATION located in metropolitan area where outdoor switchyard at 120 kv would be uneconomical, where future adjacent proprietors might eventually object to an outdoor bus, and where corrosive air would damage units

120-Kv Substation Switchyard Goes Indoors in Montreal

Oil-less circuit breakers with dry-type tap-changing feeder regulators permit housing all but the power transformers

H. W. HABERL, Apparatus & Protection Engineer
Quebec Hydro-Electric Commission

Quebec Hydro-Electric Commission's recently-completed Delorimier Substation is the third of a series of substations constructed along similar lines. It is unique in that it is an oil-less indoor substation, with a 120-kv indoor switchyard, dry-type tap-changing feeder regulator and unconventional style of construction.

In studying the economics of an indoor vs an outdoor substation, a number of factors were taken into consideration. In a metropolitan area, the electrical equipment mounted outdoors has a life expectancy of not more than 25 years. This is due to the prevalence of smoke and fumes which tend to remove the galvanizing from the structures, and rust or corrode the mechanism and current carrying parts. In addition, there are high maintenance costs for outdoor equipment. Assuming that the outdoor equipment can be housed under a protective roofing, the life expectancy of this equipment is lengthened to an indefinite period and will only be changed due to obsolescence. Should the electrical equipment involve an expenditure of over a million dollars, it can easily be proven that a protective building under these conditions would warrant its cost by reducing the maintenance to a negligible item and by protecting the electrical equipment from the elements.

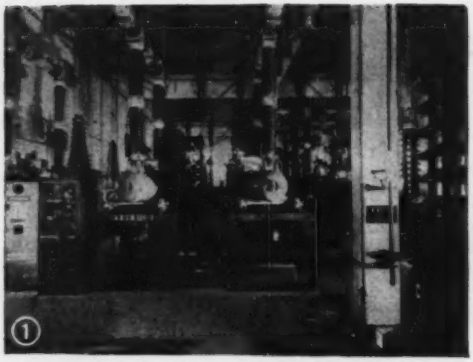
Supply to Delorimier Substation is from three 120-kv underground cables with provision for a fourth circuit; installed are four 3-phase, 120/12/4-kv bus sections tied by high current reactors, each bus section having four outgoing feeders and one spare or transfer position.

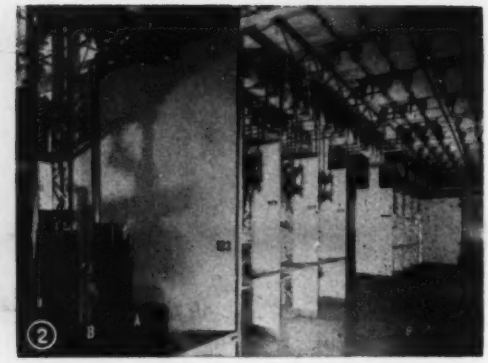
Air-blast circuit breakers are used exclusively; each distribution feeder has an individual reactor to limit the short circuit current to a safe value before delivery to customer's station, and all the 4-kv circuits have dry type 3-phase on-load automatic tap changing regulators for voltage control, arranged for line drop compensation.

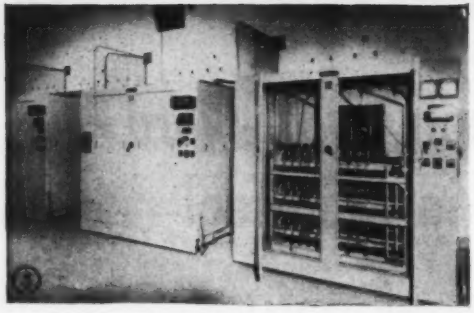
Control room houses a horseshoe shaped tunnel-type (with bench) control board, the meters being on the vertical, the control on the bench, and the relays on the rear sections. The operator's desk is in the center of the horseshoe and at his back is a station service board for all station, dc battery, and ac circuits.

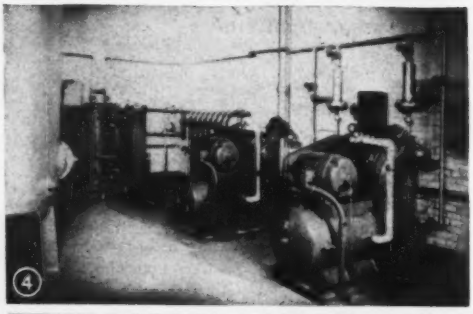
Operation of Delorimier Substation has been so satisfactory that additional stations are being designed with few major changes.

Turn page for pictures of substation interior →









Indoor 120-kv Switchyard Operates Satisfactorily with Little Maintenance

1 **BREAKER ROOM** in Delorimier Substation houses all the 120-kv equipment including ten 120-kv airblast circuit breakers (six Brown Boveri and 4 English Electric of Canada), isolating disconnects, incoming cable potheads, transformer potheads, and potential indicating devices. Behind the bushings at the extreme right is a mesh-inclosed spiral staircase leading to the 4-kv regulator room and control room

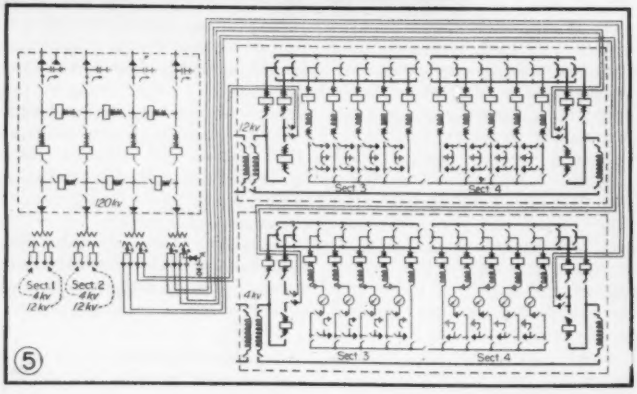
2 **OUTGOING 12-KV CABLES** start here. Overhead is the transfer bus and disconnects; at right the reactor bus ties

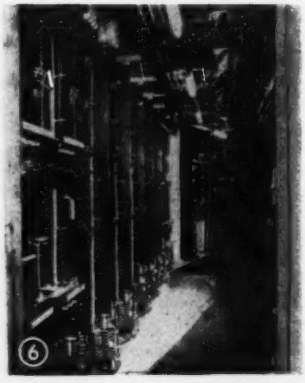
3 **DRY-TYPE**, core-exciting, and series transformers have cam-operated contactors for tap changing voltage regulator. Range is 7½% buck or boost in 9 and 17 steps with line-drop compensation and full automatic operation

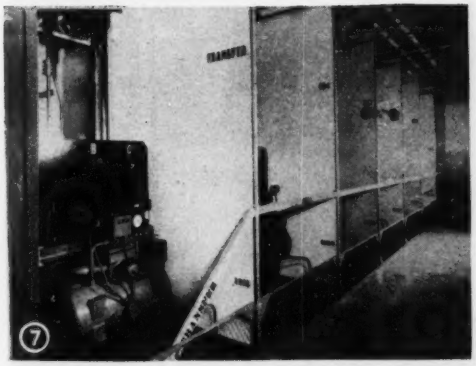
4 **AIR COMPRESSORS** have an activated alumina dryer between them and the air storage tank. A ring-bus air piping system supplies all section breakers from air headers

5 **SWITCHGEAR** sections are housed in an extension to the main building. Sections 1 and 2 (not shown) are identical to 3 and 4. Control room on the second floor of the main building is flanked by 12-kv sections; 4-kv equipment is below and regulators are below the control room

6 **TUNNEL** between control and relay panels takes all switchboard wiring, control cable terminations, etc







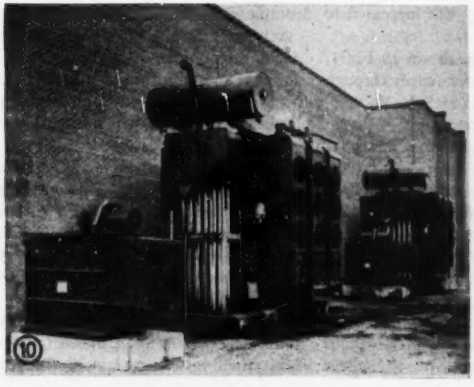
7 **FOUR OUTGOING CIRCUITS** and a spare or transfer feeder bus comprise each of the eight sections of the substation. The 12-kv airblast breakers are Brown Boveri with 600,000-kva interrupting and 1,000 amp carrying capacity

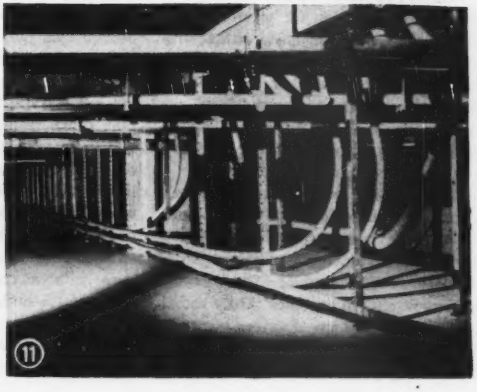
8 **TWELVE 4-KV MAIN BREAKERS** all rated 4,000 amp and an interrupting time of 3½ cycles. They are similar to the 12-kv Brown Boveri airblast breakers

9 **MIMIC BUS ON CONTROL BENCHBOARD** reproduces position of all electrical equipment in the station. Indicating and graphic instruments on the vertical panels can be read easily from the desk at the center of the horseshoe

10 **POWER TRANSFORMERS** are rated 30,000 kva and are cable fed throughout. The 120-kv cables are in compartment boxes at the rear of the transformers. The 4- and 12-kv cables leave the power transformer at the left through metering compartments. The front of the transformer is used for mounting the forced-oil forced-air coolers. As the 12 kv is delta connected the neutral is stabilized by a separate zig-zag grounding transformer which has a 300-kva, 120/208-volt, 3-phase, station service winding. The grounding transformer is shown on a separate foundation

11 **OUTGOING 12-KV AND 4-KV** distribution feeders in the station basement. The lead cables are wrapped with asbestos tape and carried on hangers until they reach the outgoing ducts. The aluminum metal conduits, at the top of the picture, carry the single conductor power cables from the 4-kv circuits to and from the regulators





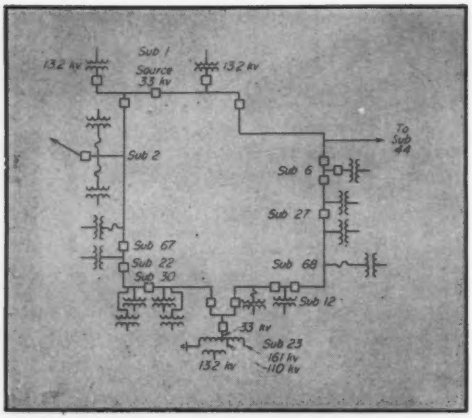


FIG 1—SECOND SUPPLY at Sub 23, near electrical center of loop, and two new loop sections made old relaying scheme obsolete. Transformer capacity of loop is 40,000 kva

FIG 2—SHIELD WIRE protection, applied to the entire loop, has reduced outages caused by lightning by 50%. This section is typical of those sections which have been rebuilt

Use Directional Distance Relaying To Solve 33-Kv Loop Problem

Provides high-speed distance relaying and back up protection for ground faults and phase faults. System is applicable to sub-transmission loop circuits

A. J. NICHOLSON
Kansas City Power & Light Company, Kansas City, Mo.

Protection developed for the 33-kv loop around greater Kansas City provides high-speed distance relaying and back up protection for ground faults, combined with high-speed distance relaying and back up protection for phase faults. The system is applicable to sub-transmission loop circuits and interconnecting transmission lines where high-speed reclosing is not required.

The 33-kv loop includes approximately 50 miles of line. For a number of years this loop has been fed from Sub 1, having a transformer capacity of 45,000 kva. These transformers also serve other 33-kv radial circuits. The loop developed over a period of years and in 1948 there were four loop sections with a total step down transformer capacity of 14,000 kva. As loads grew the loop sections were increased to six and step down transformer capacity was increased to 40,000 kva.

The existing loop, shown in Fig 1, has a second source of supply through the autotransformer at Sub 23, stepping down from 154 kv to 33 kv at approximately the electrical center of the loop. Fig 2 shows a typical line section which has been rebuilt with the addition of shield wire. Part of the loop is still of the original construction but the entire loop has shield wire with a reduction of approximately 50% in line outages caused by lightning.

In general, the line consists of 2/0 ACSR with an average equivalent spacing of 4.5 ft. The line is wood pole construction, either with flat crossarm or two crossarms. Average pole height is 50 ft, since there are distribution circuits on the same pole line. The line is completely shielded using three No. 8 Copperweld mounted on wood bayonet extensions.

Relaying . . . Protection on the original four-section loop was successfully accomplished by directional overcurrent relays. With four sections the sequential timing resulted in a minimum of 2.0 sec clearing time on heavy faults near Sub 1. Long-time heavy faults can damage the source transformers and with the increase in loop sections to six, the minimum clearing time at the source would become approximately three seconds.

In addition to damaging source transformers, the long-time clearing causes unnecessary line burn downs with increased outage time. With slow-speed relays, there have been very few successful reclosures on the first attempt.

Overcurrent relaying on a heavily loaded loop presents a difficult problem when restoring service after an

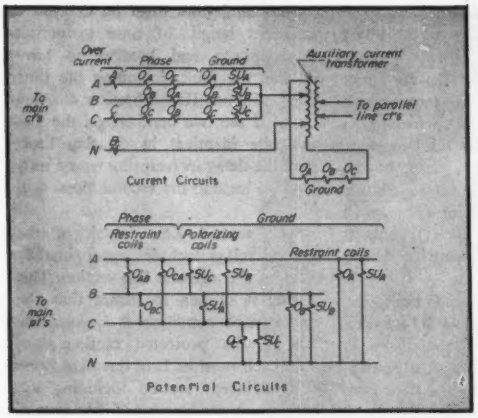


FIG 3—RELAY OPERATION can be analyzed by studying the arrangement of current and potential circuits. Accuracy of reactance measurement is —2% down to one volt

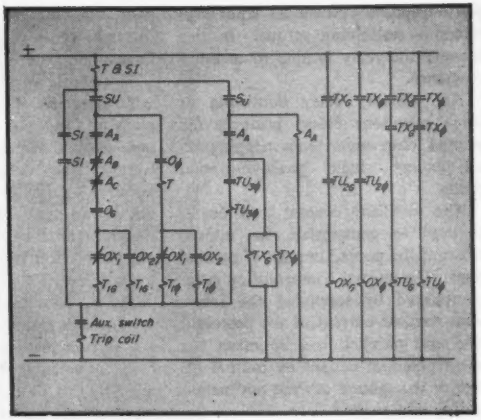


FIG 4—CIRCUIT DIAGRAM of relays for one phase only is shown above. For 3-phase protection, 64 contacts are needed. Operational sequence of relays is described on next page

outage. In this case, it was necessary to increase the relay tap settings which in some cases were higher than the short circuit currents under fault conditions.

With the added source of power on the loop it was not possible to set up a proper sequential timing that would function properly under normal and emergency conditions encountered during operations.

Relays to Meet Changes . . . An analysis of several methods of relaying resulted in the selection of "Directional Distance Relays" for the solution to the problem.

The scheme uses three reactance type ground relays for phase-to-ground and three reactance type distance relays for phase-to-phase and 3-phase faults. This method uses less equipment than the older directional distance relaying scheme by using the directional element to detect all faults, either ground or phase. The new scheme also eliminates the use of switching arrangements for selecting the faulted-phase current or potential. In general, the relays used in this scheme combine directional-reactance-distance relays for ground fault protection and reactance relays which operate with the directional-fault-detecting element of the ground relay to provide the necessary phase fault protection.

Description of Relays . . . A relaying panel for one terminal consists of the following:

- 3 relays for phase-to-ground faults.
- 3 relays for phase-to-phase, 3-phase, and double phase-to-ground faults.
- 2 dc timing relays.
- 1 auxiliary current transformer.
- 1 auxiliary blocking relay.
- 1 recloser.

Breaker control switch and signal lights as required.

The directional-reactance-distance relay for phase-to-ground fault protection consists of a directional starting unit located at the bottom of the relay. It is a 4-pole induction cup unit supplied with quadrature voltages and line current. The interaction of the flux due to quadrature voltage and line current produces the operating torque. The restraining torque is the resultant interaction of polarizing flux and a potential flux. The directional torque closes contacts when the fault current is in a definite direction and of sufficient magnitude to overcome the restraining torque. This starting unit has a circular impedance characteristic which passes through the origin on an R and X diagram. The purpose of the starting unit is to determine that a fault exists and then to determine if the fault is in the proper tripping direction.

This relay also has a reactance ohm unit of an induction cup type having four poles. The ohm unit measures accurately the distance to the fault and thus determines the zone in which the fault is located. It has two current windings which receive line current and current from auxiliary compensating current transformers. The unit also receives phase-to-neutral voltage indications through an autotransformer.

The ohm unit measures the reactance component of the impedance represented by the ratio of current and voltage applied at its terminals. With one of the current windings receiving current from an auxiliary transformer, the relay measures only the positive sequence reactance. The reach of the unit can be varied by changing taps on the autotransformer. The ohm unit is also set for a second zone reach by a separate set of taps.

The relay includes an auxiliary transfer unit of a telephone type for the purpose of changing the ohm unit from first to the second zone tap setting. Its operation is controlled by a timer.

The reactance type distance relay used for phase-to-phase and 3-phase faults merely consists of an ohm unit, autotransformer and auxiliary transfer relay for setting Zone 1 and Zone II reach. However, the two current coils are wound in opposition and are so arranged to produce 90 deg flux. One current coil is in one phase and the second coil is in another phase. The vector difference of the two currents produces the torque flux. The

phase-to-phase potential coil produces a restraining torque. In this manner the relay is able to measure reactance.

An auxiliary relay consisting of three telephone relays prevents the ground ohm units from tripping on all except single phase-to-ground faults.

The auxiliary current transformer is used to compensate for mutual effect of the ground current of parallel lines. The current compensation is accomplished by supplying the relays with residual current of the protected line and parallel lines to offset the extra potential caused by mutual effect of the ground current and neighboring line current.

Operation . . . Arrangement of the current and potential circuits are shown in Fig 3. In the current circuit there is an ohm unit with a phase current in one current winding and the compensating current from the auxiliary current transformer in the other current winding. Restraining poles are supplied with the phase-to-neutral voltage through the tapped autotransformer.

The phase ohm units are supplied with 2-phase current, one in each current winding. Also, the restraint pole is connected for phase-to-phase voltage between the 2-phase currents. As stated before, this voltage is supplied through a connection to a tapped autotransformer.

The ohm units measure the reactance within 2% plus or minus on a range of 2-40 secondary amperes and at any transmission line angle. The same accuracy can be expected down to one volt.

Each starting unit has a current coil in its respective phase, with the polarizing potential coils receiving phase-to-phase voltage. The restraining coils in turn receive phase-to-neutral voltage.

Tripping . . . Fig 4 shows the dc trip circuits with the following operational sequence: assume a phase-to-phase fault, then the starting unit will close its contacts and pick up coil of A_a and it opens either A_b or A_c to block tripping by ground relay and also closes an A_a contact to pick up auxiliary coil TX_g and $TX\Phi$ to start timers. If the fault is in the first Zone the ohm unit contact will be closed and breaker will trip through OX_1 contact and through the target $T_1\Phi$ of the phase timer.

If fault is in Zone II, the timer will close its TU_2 contacts which picks up $OX\Phi$ coil and opens its OX_1 contacts and closes its OX_2 contacts, tripping the breaker through the target T_2 of the phase timer. Should fault be in the third Zone range, then the phase timer closes its TU_3 contacts and the breaker trips through target T_3 phase timer.

For a phase-to-ground fault, the starting unit closes its two SU contacts and in turn picks up the auxiliary A_a coil. Its contacts then pick up auxiliary TX_g and $TX\Phi$ coils and their contacts in turn complete the circuits to the two timers.

Now the trip circuit for a phase-to-ground fault has been completed up to contact O_g. If the fault is in the first Zone, then the ground ohm unit O will be closed and breaker will trip through OX_1 and target T_{1g} of the ground timer. If fault is beyond the first Zone, the ground relay timer will close its TU_2 contacts and pick up OX_{2g} which changes the ohm reach and opens OX_1 contact and closes OX_2 contact to trip the breaker through the target T_{2g} of the ground relay timer.

If the fault occurs in the second Zone, then the ground relay timer will operate its TU_2 contacts, picking up OX_g which changes the ohm reach and opens OX_1 and closes OX_2 contact, tripping the breaker through target T_{2g} of ground relay timer. If fault is in the third Zone, the phase relay timer will operate its $TU_3\Phi$ contact which will cause the breaker to trip through target T_3 of phase relay timer.

There is a duplication of this contact arrangement for relays of the other two phases, giving a total of 64 contacts.

It was desirable that ground relays in general have a first Zone setting to reach 80% of the protected line section. This setting is held at 80% because of the sources of inaccuracies on ground relaying which can cause the relay to over-reach. Since Zone I trips instantaneously, its reach must be kept inside the protected section. Total relay time is one to two cycles and by adding clearing time of the breaker, total clearing time can be determined.

Reclosing time must be delayed a sufficient length of time to permit the opposite end breaker to have cleared the fault, including the time delay of Zone II and breaker clearing time. If the two breakers on the section are identical in clearing time, then the delay in reclosing would only have to include the second Zone timing.

The second Zone reach of the ground relays includes approximately 50% of the adjacent line section. This setting is chosen to insure that the under-reach condition is beyond the bus of the protected section. Also, this reach must be held less than Zone I of adjacent section including the over-reach conditions. If this second zone could see faults beyond Zone I of adjacent section, then it would be into Zone II of adjacent section, and it would require a timing to coordinate with another second Zone timing. This is undesirable since it would pyramid the section timing. Usually the normal second Zone timing is set at 0.5 sec.

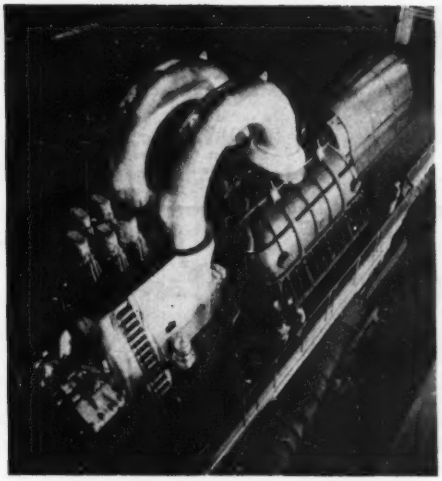
The third Zone of the ground relays is set to reach 30% into the second adjacent section and is used for back-up tripping in case of tripping failure of some section breaker. The time for Zone 3 can be set for 1.5 to 3 sec as conditions require for coordination purposes.

The third Zone reach should not be extended too far, because it may pick up and trip on load current. When it is properly set for line protection and only to include a part of the second line section, the relay will not cause a false operation by picking up on load current.

Phase Relay Settings . . . The phase relays have a first setting to reach 90% of the protected line section. It will be noted that this setting covers 10% more of the line than the ground relays. This is permitted because on phase-to-phase and 3-phase faults there are no over-reach conditions. The 90% allows for inaccuracies of the calculated reactance values. Time for Zone I is instantaneous.

The second Zone phase relay is set for 60% of the adjacent line section. Time setting for this phase relay is set at 0.5 sec.

The third Zone back-up protection is provided by the starting unit in the ground relays.



7th Steam Station Cost Survey

A. E. KNOWLTON
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ELECTRICAL WORLD

What is it costing to build and to operate utility power plants in the face of postwar costs? Comprehensive compilation and study of exclusive data about 48 such plants give an authentic index to what has been happening and where steam station costs stand today. These indexes can hardly be other than authoritative since they are based on over 5,000,000 kw of capability and over 25,000 billions of kwhr generated during 1950. Further the plants consumed over 5,000,000 tons of coal, over 12,000,000 barrels of oil, and over 90,000,000 M cu ft of gas.

Here are a few of the conclusions drawn:

1. Station costs per kilowatt are up some 70% from prewar days.

2. A kilowatt of capability may cost from $80 to $300 depending on location and fuel used.

3. For plants of more than 20 Mw capability the general average of cost is $145 per kw.

4. Coal-burning plants cost about $150 per kw of capability, oil-burning plants about $145, and gas-burning about $125.

5. A kilowatthour at the bus on the average costs from 5.8 to 13.6 mills.

6. Fixed charges now are equal to or in excess of production costs.

7. Wide spread in production costs results from range of fuel cost per million Btu from 2.5 to 36 cents.

8. Production cost averages 2.9 to 3.8 mills per kwhr and fuel represents 75% or more of this expense.

9. Metropolitan plants cost more per kw to build and to operate, despite their advantageous size, than smaller plants located where construction costs and fuel are cheap.

10. Increasing proportions of plants have gone to outdoor installation of boilers and/or fans.

11. Compromise in design to burn alternative fuels appears to entail a sacrifice of thermal efficiency.

12. Bulk of postwar capacity went into plants of 850-900 and 1250-1500 psi steam pressures.

13. Buildings comprise 18% of total station cost, boiler account 32%, turbine account 26%.

14. Maintenance expense amounts to ¼ mill per kwhr.

15. Large plants require half a man per megawatt for operation, small ones one man per megawatt.

16. Turbine space is about half that required for the boiler and its accessories.

17. Auxiliaries take about 5½% of the generated energy but more than that for small plants.

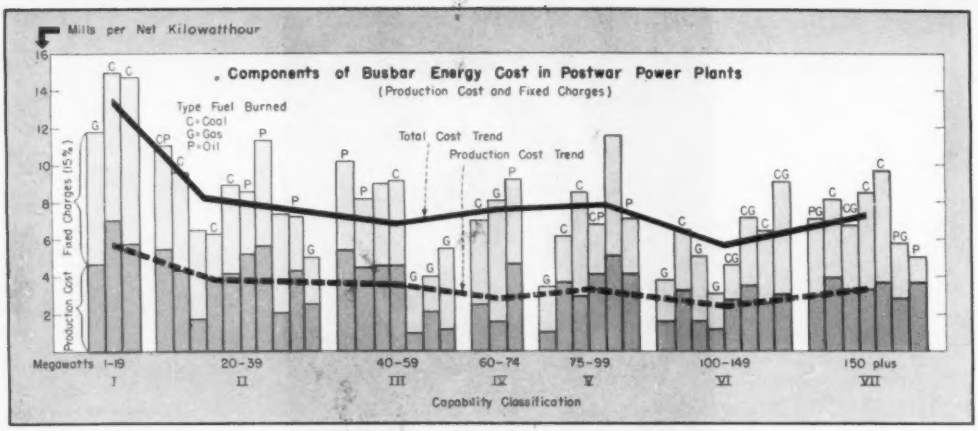


FIG 1—KILOWATTHOUR COST AT BUSBAR consists of 3.65 mills for production and 4.75 mills for fixed charges

Generating Costs Have Risen

New designs successfully prevented large increase. Fixed charges now greater than production cost. Extensive shift from coal to gas and oil

Despite the rise in costs of fuel and of power plant construction the cost of a kilowatthour in 1950 at the buses of postwar plants was only slightly higher than was found for late war and postwar plants ready for operation through 1949. The increase in production cost was, on the average, about 0.2 mill per kwhr and the overall cost is about 0.7 mill higher. In other terms, the production cost has gone up from 3.2 to approximately 3.65 mills and the overall cost from 6.2 to 8.4 mills. The fixed charges allocated to each kilowatthour are thus 4.75 mills and they now represent more than half the total busbar cost. These are taken at 15% of the investment per kw of plant capability rather than on the manufacturers' rating of the units.

Based on Capability . . . The step has been taken in this survey to bring the indexes into conformity with the trend to place more statistical emphasis on capability than upon arbitrary ratings.

In defense of the 15% rate for fixed charges (considered high by some) it can be said that too low a figure would be undesirable and that rising taxes may tend to raise a lower percentage where such is used.

Production Cost . . . Spread of production cost ranges from a value of 1.2 mills for a medium-sized plant burning natural gas to 7.1 mills for a small plant burning coal. Small plants generally reflect higher per kwhr costs than the larger ones, as may be logical. On the other hand, the very largest plants do not show the lowest costs per kwhr and this can readily be attributed to the fact that they are generally in metropolitan areas where land, fuel, and construction costs run above the national averages.

Coal is still the prime fuel in the majority of plants

Megawatt Group*	I	II	III	IV	V	VI	VII	Total
Coal	2	2	4	3	3	2	3	19
Oil	0	0	5	1	0	2	1	9
Gas	0	2	4	1	1	3	0	11
Coal and oil**	0	0	0	0	0	0	1	1
Coal and gas**	1	0	0	0	0	2	2	5
Oil and gas	0	0	0	0	0	0	3	3

* Groups have these ratings: I, 0-19 Mw; II, 20-39 Mw; III, 40-50 Mw; IV, 60-74 Mw; V, 75-99 Mw; VI, 100-149 Mw; and VII, over 150 Mw.
** For more than light-off quantities.

Influence of Fuel . . . Accompanying data in the table below show that 19 of the 48 plants burned coal, 11 burned natural gas, 9 burned oil, 5 coal and gas, 3 oil and gas, 1 coal and oil, during 1950. Eight of the oil-using plants are outside the oil-producing area and four of the plants which burned gas and coal are outside the gas-producing areas but on gas pipelines.

Outdoor Installation . . . Twenty of the 48 plants have their boilers entirely or partly outdoors and 22 have the fans outdoors (in two of these instances only the induced-draft fans). Such design is most common in areas where cheap natural gas is also available. Consequently the inherently low production cost in these areas is coupled with low unit plant costs to result in a low overall kilowatthour cost in these favorably situated regions. Roughly the natural gas plants turn out a kwhr at not much over half the general average for all plants.

Plant Costs Up, Buildings Down

Postwar station cost up 70% from prewar. Simplified buildings comprise only 18% of total station costs. Boilers and turbines are 32% and 26% respectively

The $100 per kilowatt power plant appears to have become a thing of the past. Of the 48 plants in this station cost survey only three cost less than $100 and two of these report burning only gas for fuel. In fact the rising cost of construction has set the 1944-49 plants at a minimum average of $135 and the general trend for plants of more than 20 Mw of capability at $140 to $145. As might be expected of the largest plants the average is at $155 due to higher costs in metropolitan areas. Smallest plants cost nearly double the average for the others.

In comparing these figures with those of preceding Steam Station Cost Surveys it should be recognized that the present ones are based on capability and not on rated capacity as in the previous instances. The difference is a matter of 14.4% as evidenced by the 4,471 Mw total rating for the 48 plants as against a capability aggregate of 5,113 Mw. Putting the present data on a "rated" basis would lift the above figures of $135 to $154, of $140 to $160, and of $155 to $177. On this basis this 7th survey reflects an increase of at least 70% over prewar costs (1910-1947 trend).

Design Objectives . . . Had it not been for the success of the designers in simplifying station layouts the costs would undoubtedly have been up toward double the prewar costs. Unit plants, metal walls, boilers and fans all or partly outdoors, centralized control and, to some extent, the switch to oil and gas for fuel have all conspired to prevent such skyrocketing. Adoption of higher steam pressures and temperatures along with selection of preferred standard units have also aided in holding the cost level down.

Building Outlay . . . Power plant building outlays per kw are down from the 26% average reported in the 6th Steam Station Cost Survey. Separate data for this item are given for 27 of the 48 plants and they show a current average of 18% with a spread from 5.5% to 37.75%. Coal-burning plants present a 23.2% average (spread 15.6 to 37.75%), oil burning plants 13.6% (spread 9.7 to 17.3%), and gas burning plants 11.1% (spread 5.5 to 18.7%).

Building costs are not lower per se except insofar as compactness in design or resort to outdoor location of equipment have permitted a relatively smaller structure. They are a lower portion of the total plant cost for the further reason that equipment costs have risen higher than the modern plant building costs to house them. Other factors in holding down the building costs are the use of metal and composition panels for the outer walls and the growing tendency to substitute grillage for poured concrete floors. Some plants have only islands for the turbines and no real turbine floor.

Boilers and Turbines . . . Boiler account (312) has charged to it amounts which constitute about 32% of the total plant cost. For the seven capability groupings they range from $45 to $95 (the latter for small plants). As a percentage, however, the boiler item is consistently between 28.2% and 34.5% for all groups. In Fig 2 the ordinate values are arranged in order of descending magnitude for better visualization. Consequently the boiler, turbine (plus accessories) items on any vertical line are not necessarily those associated with the total plant value plotted above them. Turbines and accessories (Account 314) amount to an average 26.3% of the total plant costs. The item ranges from 30% for small and medium-sized plants to 23% for large ones.

Arranged in this manner the individual variations disappear and there results a significant proportioning of the costs for the major components—building steam equipment and electrical equipment.

(Text continued on page 106)

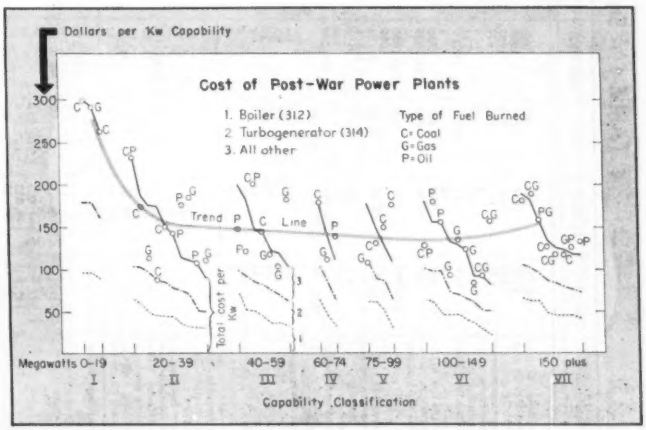


FIG 2—A KILOWATT OF CAPABILITY costs from $82 to $300. Average is $145 for steam stations with capability ratings ranging from 20 Mw to over 150 Mw

TABLE I — Steam Station Equipment Data and Production Costs (1950)

Station Number	143 (59)	144 (114)	145	146 (142)	147	148 (139)	149	150	151	152	153	154 (141)	155 (116)	156 (41)	157 (117)	158 (129)
Normal function[1]	(d) (e)	(d)	(d)	(d)	(a)	(d)	(a)	(a)	(a)	(d)	(d)	(a)	(a)	(a)	(a)	(a)
Year, initial operation	1943	1948	1948	1948	1947	1942	1948	1948	1948	1948	1951	1949	1949	1947	1948	1948
latest unit	1949	1949	1949	1951	1950	1950	1950	1950	1949	1951	1951	1949	1949	1950	1949	1950
Total gen. rating (nameplate)[2]	VII	VII	VII	VII	VII	VII	VII	VII	VI	VI	VI	VI	VI	VI	VI	VI
No. of turbogenerators	5	3	4	4	5	5	3	4	3	2	2	2	2	2	2	2
Total capability rating[3]	VII	VII	VII	VII	VII	VII	VII	VII	VII	VII	VI	VI	VI	VI	VI	VI
Range, capab'y. basis(Mw)[3]	V-V	VI	IV-V	IV-IV	III-III	II-IV	IV-IV	III	.....	II-V	.....	IV	IV-IV	III-III	IV	.....
No. of boilers	5	5	7	4	8	5	3	4	3	3	2	2	2	3	4	2
Rating range (M lbs/hr)	675–825	950	400	550	285–313	12–640	120–600	1800–2068	450–480	300–550	625–650	600	675	400–425	285	215
Steam pressure psi	900	1500	875	1250/1500	850	650/850	950	1380	1250	1250	1250	850	920	1250	875	920
Steam temp. INITIAL superheat (F)	915/900	1050	900	950/1000	900	900	900	935	1000	930	950	900	905	950	900	905
Reheat (F)	.....	.....	.....	1000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cooling water range (F)	66–56	78–33	72–52	81–34	92–32	80–34	85–32	95–70	90–32	84–32	87–33	86–46	93–54	92–51	90–32	91–50
Corresponding vacuum(in. Hg)	1.6–0.7	.....	1.94–1.06	2.3–1.1	2.0–0.35	1.76–0.81	1.5–1.0	3–1.5	2.0–0.35	2.0–1.0	2.5–0.6	2.56–1.16	2.12 Avg	27.52–29.02	1.65–0.61	2.92–0.88
Plant site area (acres)	14.9	155	50.0	178	117	47	352	160	140	30	330	189.8	401	36.7	.....	.....
In use (acres)	14.9	65	25.0	124	117	47	85	79	140	30	165	54.3	401	.....	.....	.....
Fuel storage cap., coal (tons)	.....	150,000	.....	180,000	250,000	200,000	500,000	.....	225,000	150,000	500,000	150,000	.....	.....	125,000	.....
Oil (bbl)	900,000	125,000	200,000	.....	60,000	.....	.....	240,000	6,000	.....	.....	.....	25,000	50,000	1,667	570,000
Gas (M cu. ft.)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Employees, total (24 hours)	155	147	117	94	138	165	86	37	102	77	60	73	42	56	78	46
Operation	85	71	83	43	59	114	47	24	44	30	43	43	23	37	36	38
Maintenance	52	24	25	35	39	23	20	8	25	15	7	13	12	8	26	8
Clerical stores	13	12	5	4	15	3	2	5	15	6	3	4	3	3	5	.....
Fuel handling	2	11	.....	8	20	22	13	.....	13	6	7	11	0	.....	7	.....
Guards	3	4	4	4	5	3	4	.....	5	0	0	3	4	8	4	.....
Station Details																
Car thawer, car dumper	—, —	—, —	—, —	—, √	—, —	—, —	—, —	—, —	√, —	—, —	√, Fut.	—, —	—, —	—, —	√, —	—, —
Pulverizers, stokers	—, —	√, —	—, —	√, —	—, √	√, —	√, —	—, —	√, —	—, —	√, —	√, —	—, —	—, —	√, —	—, —
Unit plant, boiler header	√, —	√, —	—, √	√, —	—, √	√, —	—, √	—, √	—, √	—, √	√, —	√, —	—, —	—, —	—, √	√, —
Outdoor boiler, outdoor fans	—, —	semi, √	√, √	Semi, ID	—, —	—, —	—, —	Semi, √	—, —	—, —	√, √	—, —	√, √	√, √	—, √	√, √
Fan couplings: H(ydr), E(lec)	—, —	H, —	—, —	H, E	H, —	—, E	H, —	—, —	H, —	—, —	—, E	H, —	—, —	—, —	—, E	—, —
Spray pond, cooling tower	—, —	—, —	—, —	—, —	—, —	—, —	—, —	—, √	—, —	—, —	—, √	—, —	—, —	—, —	—, —	—, √
Flyash coll.: M(ech), E(lec)	—, —	M, E	—, —	M, —	—, —	—, E	M, —	—, —	M, —	—, E	M, Fut.	—, E	—, —	—, —	—, —	—, —
Centr. control, isol. phase bus	—, —	√, —	—, √	√, √	part, —	—, —	—, —	√, 13.8 Kv	part, —	√, —	√, —	—, —	√, —	√, —	—, —	√, —
Fuel Consumption Data																
Coal, (short tons)	.....	.....	.....	355,270	467,394	603,440	426,700	.....	151,022	530,828	251,234	171,964	.....	.....	42,239	.....
Btu/lb	.....	.....	.....	12,780	10,417	11,452	11,862	.....	11,135	11,650	11,500	11,800	.....	.....	10,351	.....
Ash (%), moisture (%)	.....	.....	.....	7.98; 6.56	10; 16	11.59; 9.44	11.0; 9.9	.....	10; 15–16	14.1; 6.5	12; 15	12.06; 6.13	.....	.....	10.4; 15	.....
Cost, ¢/million Btu	.....	.....	.....	28.92	21.2	20.8	29.67	.....	23.4	18.3	22	27.97	.....	.....	24	.....
Oil (bbl)	1,397,982	3,984,839	1,329,284	.....	19,250	.....	.....	944,928	2,370	.....	.....	115	2,063	862	3,057	2,322
Btu/gal	149,041	149,333	152,096	.....	140,000	.....	.....	148,810	140,000	.....	.....	150,000	147,619	146,560	137,893	142,857
Cost, ¢/million Btu	21.84	30.53	21	.....	64.2	.....	.....	20.0	58.5	.....	.....	70.36	24.3	34.85	74.4	48.5
Gas (M cu. ft.)	4,387,913	.....	12,725,406	.....	.....	384,295	.....	5,820,616	4,634,844	12,254	3,258,266	8,242,642	10,243,345	7,919,858	.....	3,961,098
Btu/cu. ft.	1,100	.....	1122.8	.....	.....	944	.....	1035	1023.3	1,080	1,000	1,030	1,075	1,111	.....	1,070
Cost, ¢/million Btu	18.64	.....	18.5	.....	.....	22.2	.....	18.5	18.5	43.2	13.5	16.65	7.5	9.00	.....	8.056
Output Data																
Totalgrossgen.(millionskwhr)	1,191	2,546	1,980.3	887	875.7	1,255	935.94	1039.9	766.0	1,151.5	845.1	1,092.6	947	762.3	801	353.8
Total net gen. (millions kwhr)	1,126	2,406	1,897.0	833	819.9	1,162	895.18	930.6	722.6	1,077.9	790.0	1,048.6	895	716.3	760	335.5
Maximum 1-hr peak (Mw)	303.35 Gr.	348	304	132	250	274	183.1	195 Gr.	157.5	169.3	132	144.8	140,600	133	129	49
Hours operation 1950	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,760	8,696	8,760	8,760	8,760	8310.6
Operating Costs (Mills per NET kwhr)																
Fuel	2.4966	3.171	2.33	3.186	2.623	2.54	3.36	2.466	2.302	2.113	2.85	2.431	0.93	1.108	2.767	0.99
Wages and superintendence	.....	0.224	0.22	0.308	0.414	0.40	0.24	0.294	0.333	0.224	0.26	0.268	0.12	0.300	0.272	0.50
Water, lubrication, supplies	.....	0.055	0.04	0.051	0.067	0.10	0.03	0.062	0.177	0.039	0.04	0.027	0.02	0.040	0.037	.....
Maintenance, repairs																
Buildings and structures	.....	0.026	0.014	0.009	0.0041	0.024	0.071	0.004	0.0087	0.0068	.....	0.012	0.012	0.016	.....	.....
Boiler plant	.....	0.065	0.058	0.048	0.0698	0.084	0.059	0.044	0.0592	0.0210	.....	0.006	0.030	0.107	.....	.....
Fuel handling	.....	0.012	0.006	0.022	0.0405	0.066	0.083	.....	0.0266	0.0324	.....	0.007	0	.....	.....	.....
Prime movers and aux.	.....	0.028	0.057	0.013	0.0464	0.076	0.032	0.024	0.0422	0.0049	.....	0.001	0.037	0.018	.....	.....
Electrical equipment	.....	0.008	0.010	0.003	0.0083	0.013	0.002	0.006	0.0110	0.0027	.....	0.001	0.017	0.006	.....	.....
Supervision, engrg., misc.	.....	0.021	0.025	0.051	0.0203	0.029	0.040	0.016	0.0313	0.0196	.....	0.021	0.010	0.029	.....	.....
Total maintenance	.....	0.160	0.17	0.146	0.195	0.29	0.29	0.094	0.1790	0.087	0.36	0.047	0.10	0.176	0.163	0.20
Total oper. and maint. (excl. fuel)	.....	0.439	0.43	0.505	0.676	0.79	0.56	0.450	0.689	0.351	0.66	0.342	0.24	0.516	0.472	0.70
Total production (incl. fuel)	.....	3.610	2.76	3.691	3.299	3.33	3.92	2.916	2.991	2.464	3.51	2.773	1.17	1.624	3.239	1.69

(Continued on page 102)

TABLE II — Steam Station Unit Investment Cost, Total Power Cost and Performance (1950)

Station Number	143 (59)	144 (114)	145	146 (142)	147	148 (139)	149	150	151	152	153	154 (141)	155 (116)	156 (41)	157 (117)	158 (129)
Investment Data (Dollars per kw of capability)																
(310) Land	.....	0.7	1.56	0.35	0.34	0.27	0.72	0.30	5.98	0.10	2.69	0.40	0.72	1.81	0.39	1.76
(311) Structures, improvements	.....	25.1	20.82	31.84	32.79	21.22	34.10	14.11	61.25	58.46	37.02	18.33	13.56	33.32	35.01	19.45
(312) Boiler plant equipment	.....	54.2	45.95	47.61	46.35	42.13	48.10	63.13	61.48	66.22	56.07	33.95	22.53	39.89	45.35	28.30
(314) Turbogenerator unit	.....	27.2	37.74	29.80	24.46	31.06	26.30	39.47	32.70	33.40	40.55	27.62	31.63	25.70	26.24	27.15
(315) Accessory elec. equipt	.....	18.6	12.13	8.39	6.84	10.16	6.94	25.43	14.77	10.98	13.58	5.47	6.92	9.01	7.76	7.78
(316) Misc. plant equipt	.....	1.5	1.68	0.94	1.83	1.33	0.71	12.45	3.77	4.19	1.51	1.26	0.54	.....	1.69	1.12
Total station	.....	127.3	9.88	118.93	112.61	106.18	116.87	144.89	179.95	173.35	151.44	87.03	75.90	110.80	116.44	85.56
Outdoor switchyard	.....	4.0	6.12	7.22	6.99	11.40	10.99	11.85	8.99	7.64	7.50	6.03	7.59	11.60	15.66	6 41
Total, station and switchyard	.....	131.3	126.00	126.15	119.60	117.58	127.86	156.74	188.94	180.99	158.94	93.06	83.49	122.40	132.10	91.97
Building	.....	18.7	.....	.....	21.73	.....	23.24	11.16	32.29	51.17	22.60	.....	5.15	.....	.....	.....
Condensing supply works	.....	3.2	.....	.....	7.71	.....	3.90	9.53	19.80	3.78	13.05	.....	5.77	.....	.....	.....
Fuel handling	.....	12.3	.....	.....	6.45	.....	16.96	5.85	7.94	20.66	9.56	.....	1.21	.....	.....	.....
Ash handling	.....	4.2	.....	.....	1.54	.....	1.11	.....	1.34	5.54	1.09	.....	.....	.....	.....	.....
Draft system	.....	5.2	.....	.....	4.36	.....	4.48	3.51	5.12	3.14	1.98	.....	.....	.....	.....	.....
Feedwater system	.....	5.5	.....	.....	3.45	.....	1.55	5.20	10.16	11.77	4.52	2.94	.....	.....	.....	.....
Piping system	.....	11.6	.....	.....	11.13	.....	4.09	13.95	11.35	11.82	8.42	4.13	.....	.....	.....	.....
Condensers	.....	2.5	.....	.....	1.75	.....	3.21	2.58	4.14	3.91	5.78	5.96	.....	.....	.....	.....
Switchgear, station wiring	.....	17.1	.....	.....	9.58	.....	6.81	21.95	14.56	11.30	10.96	6.46	.....	.....	.....	.....
Cost of Energy (Mills per NET kwhr)																
Fixed charges at 15%	.....	1.809	3.03	5.998	5.15	3.43	4.24	4.554	6.163	4.080	3.71	1.864	1.89	3.409	3.259	2.18
Production charges (Table I)	.....	3.610	2.76	3.691	3.299	3.33	3.92	2.916	2.991	2.464	3.50	2.773	1.17	1.624	3.239	1.69
Total	.....	5.419	5.79	9.689	8.449	6.76	8.16	7.470	9.154	6.544	7.21	4.637	3.06	5.033	6.498	3.87
Station Performance 1950																
Billions Btu used	13,778	24,994	22,779	9,173	9,850	14,190	10,123	11,930	8,120	1,238	10,260	12,549	11,025	8,801	8,778.8	4,036.5
Fuel cost, ¢/million Btu	20,705	30.53	19.4	28.92	21.87	20.9	29.67	19.2	20.5	18.3	2.5	20.31	7.5	9.02	24.0	8.20
Btu/NET kwhr send out	12,058	10,389	12,008	11,014	12,015	12,216	11,302	12,820	11,238	11,490	11,400	11,967	12,323	12,286	11,530	12,030
Btu/GROSS kwhr generated	11,400	9,816	11,503	10,340	11,249	11,307	10,809	11,473	10,600	10,760	10,670	11,485	11,646	11,546	10,936	11,410
Aver. boiler efficiency (%)	86.64	86.9	86	89.21	84	85.7	87.3	85	84	87.5	88	84.7	83.3	84.2	86.64	85.3
Sta thermal efficiency, NET (%)	28.31	32.9	28.4	30.99	28.42	27.9	34.2	26.64	30.4	29.7	29.9	28.2	27.6	27.8	29.60	28.4
Employees per 1000 KW per day	0.603	0.45	0.41	0.356	0.55	0.66	0.43	0.190	0.62	0.47	0.36	0.58	0.31	0.42	0.624	0.37
Plant factor, annual (%)	37.5	88.1	94.19	72.66	58.5	72.1	79	63.4	100	82.3	85.8	103.94	77.5	61.48	86.75	107.5
Utilization factor, annual (%)	85.9	105.5	126.67	110	125	119.1	106	102.4	131	108.4	110	125.94	106.5	100.0	129.0	139.6
Station Space Factors																
Boiler room (cu. ft./kw)	11.77	8.15	0.48	9.2	.....	22.2	12.27	.....	.....	25.3	OD	9.86	.....	1.62	.....	.....
Turbine room (cu. ft./kw)	15.09	9.06	7.3	9.4	.....	14.2	6.45	7.60	.....	10.0	6.82	9.34	.....	3.43	.....	0.0079
Switch house (cu. ft./kw)	0.45	.....	0.217	.....	.....	0.3	0.27	.....	.....	2.6	0.70	.....	.....	OD	.....	0.00224
Office, employee areas (cu. ft./kw)	0.42	0.803	0.5	0.79	.....	0.3	0.48	0.29	.....	8.4	0.664	0.86	0.52	0.49	.....	0.089
Bldg., ground area (sq. ft./kw)	1.83	0.202	0.26	0.303	.....	0.41	0.20	0.16	.....	0.4	0.240	0.15	0.004	0.20	0.0397	0.0736
Switchyard (sq. ft./kw)	0.06	0.365	0.11	0.233	.....	0.46	0.98	0.42	.....	0.3	0.833	0.06	.....	1.04	0.74	0.353
Fuel storage area (sq. ft./kw)	0.75	0.75	0.75	0.85	.....	1.80	4.4	2.08	.....	2.0	5.78	2.49	.....	1.01	4.2	0.0804
Coal storage (tons/kw)	.....	0.45	.....	0.68	.....	0.80	2.53	.....	.....	0.85	3.57	1.07	.....	0.38	1.0	.....

(†) Normal function: (a) Normal system station; (b) Normal distribution station; (c) Normal transmission station; (d) Normal base load; (e) Standby.

(‡) Rating groups, Mw: I, 0 to 19; II, 20–39; III, 40–59; IV, 60–74; V, 75–99; VI, 100–149; VII, 150 plus.

(Continued on page 103)

TABLE I — Steam Station Equipment Data and Production Costs (1950) — (Continued)

Station Number	159	160 (130)	161	162 (122)	163 (93)	164 (52) (45)	165	166 (126)	167	168 (121)	169	170	171 (25)	172 (128)	173	174 (131)
Normal function[1]	(a)	(a)	(a)	(a)	(a)	(a) (c) (d)	(a)	(a) (c) (d)	(a) (c)	(a)	(d)	(a)	(a)	(c)	(d)	(a) (c) (d)
Year, initial operation	1948	1948	1949	1949	.....	1949	1940	1948	1950	1947	1950	1949	1947	1948	1945	1947
latest unit	1950	1950	1950	1950	1949	.....	1949	1949	1950	1948	1950	1951	1949	1949	1949	1949
Total gen. rating (nameplate)[2]	V	V	V	V	V	V	V	IV	IV	III	IV	II	III	III	III	III
No. of turbogenerators	3	2	2	1	1	1	3	3	2	2	2	1	2	4	2	2
Total capability rating[2]	VI	VI	VI	V	V	V	V	IV	IV	IV	IV	II	IV	III	III	III
Range, capab'y. basis(Mw)[2]	II	III	III	III to III	V	V	.....	I to III	.....	II	II	II	II	.....	II-II	.....
No. of boilers	4	2	2	2	2	2	5	3	2	4	3	2	2	4	2	2
Rating range (M lbs/hr)	200 to 275	425	882	425	90 to 410	500	950	430	650	90 to 170	215	300	275	150	230	570
Steam pressure psi	900	1250	1350	1250	1250	820	375/800	1250/600	850	900	875	850	850	650	850	850
Steam temp. INITIAL superheat (F)	900	950	955	950	950	950	725/835/900	950/825	900	900	910	900	900	835	900	900
Reheat (F)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cooling water range (F)	88–56	73–31	85–36	86–73	79–33	85–35	86–46	91–58	86–50	78–37	78–38	94–70	74–36	103–51	83–52	93–38
Corresponding vacuum (in. Hg)	2.8–1.1	1.56–0.55	2.26–0.64	19.1–1.5	2.01–0.88	2.4–0.6	3–0.75	.....	2.01–0.75	2.07–0.83	2.0–1.0	3.3–2.2	1.42–0.60	2.52–1.56	2.0–0.8	.....
Plant site area (acres)	34.9	71.56	853.7	1116	.....	43	74.5	82	45	.....	400	50	9.8	.....	145	64
In use (acres)	15	48.71	.....	65	86.4	40	18	50	18	.....	25	25	9.8	.....	.....	20
Fuel storage cap., coal (tons)	.....	110,000	150,000	150,000	.....	60,000	.....	.....	.....	75,000	100,000	.....	50,000	.....	.....	.....
Oil (bbl)	100,000	80,000	15,000	75	.....	0	50,000	110,000	.....	.....	.....	40,000	200	57,000	20,000	10,000
Gas (M cu. ft.)	.....	.....	.....	.....	.....	0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Employees, total (24 hours)	68	70	55	60	.....	49	48	66	25	65	65	30	45	54	45	30
Operation	45	26	32	24	24	25	18	39	16	36	47	21	28	42	32	16
Maintenance	15	29	15	24	.....	17**	24	23	7	13	8	9	7	12	13	12
Clerical stores	3	5	2	5	.....	2**	4	4	1	6	7	.....	2	.....	.....	1
Fuel handling	1	2	8	9	4	3**	.....	.....	.....	9	7	.....	6	.....	.....	.....
Guards	4	.....	0	.....	.....	2**	2	.....	.....	1	1	.....	2	.....	.....	.....
Station Details																
Car thawer, car dumper	—, —	—, —	—, —	—, —	—, —	√, √	—, —	—, —	—, —	√, —	√, —	—, —	—, —	—, —	—, —	—, —
Pulverizers, stokers	—, —	√, —	√, —	√, —	√, —	√, —	—, —	—, —	—, —	√, —	√, —	—, —	√, —	—, —	—, —	—, —
Unit plant, boiler header	—, √	√	√, —	√, —	√, √	—, √	√, √	HP, LP	√, —	—, √	—, √	√, —	√, —	√, √	√, —	√, —
Outdoor boiler, outdoor fans	—, √	semi, ID	√, √	√, √	—, —	—, —	—, —	√, √	√, —	—, —	—, √	√, √	—, —	√, √	—, —	√, √
Fan couplings: H(ydr), E(lec)	—, —	—, —	H, —	H, —	H, —	—, —	—, —	—, —	—, —	H, —	H, —	—, —	H, —	—, —	—, —	—, —
Spray pond, cooling tower	—, —	—, —	—, √	—, √	—, —	—, —	—, —	—, —	—, —	—, —	—, √	—, √	—, —	—, √	—, —	—, —
Flyash coll.: M(ech), E(lec)	—, —	M, E	M, —	M, —	—, —	M, E	—, —	M, —	—, —	—, —	M, —	—, —	M, —	—, —	—, —	—, —
Centr. control, isol. phase bus	—, —	√, √	√, —	√, —	—, √	√, √	—, —	—, —	—, —	—, —	—, —	√, —	—, —	√, —	—, —	—, —
Fuel Consumption Data																
Coal, (short tons)	.....	.....	236,772	74,900	224,988	335,858	.....	.....	.....	208,830	248,160	.....	170,184	.....	.....	.....
Btu/lb	.....	.....	13,933	11,370	12,797	12,047	.....	.....	.....	11,460	11,181	.....	12,021	.....	.....	.....
Ash (%), moisture (%)	.....	.....	5.5; 4.0	9.9; 10.1	10.25; 5.76	10.80; 6.76	.....	.....	.....	11.5; 10.7	12; 10	.....	9.3; 8.1	.....	.....	.....
Cost, ¢/million Btu	.....	.....	33.3	17.6	25.4	28.54	.....	.....	.....	24.9	16	.....	32.3	.....	.....	.....
Oil (bbl)	776,808	722,372	74,727	.....	.....	.....	310	669,877	.....	.....	.....	.....	.....	407	.....	.....
Btu/gal	149,634	149,370	140,000	.....	.....	.....	142,500	150,145	.....	.....	.....	.....	.....	142,857	.....	.....
Cost, ¢/million Btu	28.2	34.66	.....	.....	.....	.....	35.2	31.3	.....	.....	.....	.....	.....	36.3	.....	.....
Gas (M cu. ft.)	.....	.....	.....	.....	.....	.....	6,621,071	.....	2,002,494	.....	.....	2,409,350	.....	5,468,595	5,077,621	4,390,980
Btu/cu. ft.	.....	.....	.....	.....	.....	.....	1,083	.....	1,051	.....	.....	1,074	.....	1,082	1,000	1,025
Cost, ¢/million Btu	.....	.....	.....	.....	.....	.....	3.51	.....	8.4	.....	.....	12.5	.....	5.0	11.8	.....
Output Data																
Total gross gen. (millions kwhr)	435	430.3	612.8	161	546.6	750.97	561.8	376.7	181.74	402	506.8	212.44	368.6	456.9	411.1	403.6
Total net gen. (millions kwhr)	413.6	407	580.1	146	513.0	715.68	538.4	354.0	171.91	376	481.2	200.01	348.4	432.2	396.8	388.4
Maximum 1-hr peak (Mw)	110	100.2	102	91	96	104***	92.1	76.6	71.7	70	(Net) 73.8	34.4	57.7	56.3	50	57.7
Hours operation 1950	8,760	8,954.5	8,437.9	2,872*	7,020	8,511	8,760	8,759.5	8,476	8,760	8,244	8,155.3	8,753.5	8,760	8,756	8,757
Operating Costs (Mills per NET kwhr)																
Fuel	3.331	3.858	3.70	2.07	2.851	3.26	0.471	3.74	0.9082	3.328	1.88	1.62	3.837	0.69	1.51	0.717
Wages and superintendence	0.426	0.412	0.16	0.34	.....	0.256	0.237	0.46	0.337	0.667	0.31	0.43	0.323	0.38	0.34	0.188
Water, lubrication, supplies	0.102	0.063	0.03	0.17	.....	0.039	0.091	0.07	0.131	0.068	0.03	0.06	0.054	.....	0.04	0.044
Maintenance, repairs																
Buildings and structures	0.014	0.027	0.004	0.016	.....	0.0073	0.040	0.01	0.0065	0.0398	0.06	0.01	.....	.....	0.02	0.004
Boiler plant	0.070	0.190	0.092	0.106	.....	0.1299	0.066	0.17	0.057	0.0744	0.06	0.14	.....	.....	0.05	0.037
Fuel handling	.....	0.008	0.036	0.004	.....	0.0429	.....	.....	.....	0.0494	0.03	.....	.....	.....	0	.....
Prime movers and aux	0.044	0.043	0.046	0.165	.....	0.0310	0.101	0.12	0.028	0.0453	0.01	0.13	.....	.....	0.05	0.024
Electrical equipment	0.007	0.012	0.018	0.016	.....	0.0024	0.102	0.04	0.022	0.0300	0.01	0.01	.....	.....	0.01	0.013
Supervision, engrg, misc	0.026	0.088	0.038	0.018	.....	0.0047	0.203	0.02	0.088	0.0450	0.04	0.04	.....	.....	0.03	0.020
Total maintenance	0.161	0.368	0.24	0.32	.....	0.218	0.242	0.36	0.202	0.284	0.22	0.33	0.263	0.17	0.16	0.098
Total oper. and maint. (excl. fuel)	0.689	0.843	0.43	0.83	.....	0.513	0.570	0.89	0.67	1.019	0.56	0.82	0.640	0.55	0.54	0.330
Total production (incl. fuel)	4.020	4.701	4.13	2.90	.....	3.773	1.041	4.63	1.652	4.347	2.44	2.44	4.477	1.24	2.05	1.047

(Continued on page 104)

TABLE II — Steam Station Unit Investment Cost, Total Power Cost and Performance (1950) — (Continued)

Station Number	159	160 (130)	161	162 (122)	163 (93)	164(52)(45)	165	166 (126)	167	168 (121)	169	170	171 (25)	172 (128)	173	174 (131)
Investment Data (Dollars per kw of capability)																
(310) Land	4.80	3.65	0.75	0.40	.....	0	1.12	0.61	1.50	.....	0.4	1.446	.....	0.20	0.42	0.37
(311) Structures, improvements	28.17	54.13	34.79	39.20	44.89	26.50	23.56	33.47	23.15	.....	46.7	19.257	.....	63.12	20.54	25.11
(312) Boiler plant equipment	46.38	65.33	46.53	62.80	50.70	61.12	25.67	49.00	32.77	.....	65.1	31.232	.....	52.68	31.05	35.16
(314) Turbogenerator unit	50.85	34.37	30.54	46.50	34.06	28.76	35.61	36.72	36.02	.....	38.7	42.930	.....	40.15	34.48	33.34
(315) Accessory elec. equipt.	35.43	12.78	7.34	14.80	10.41	9.69	10.77	8.37	6.43	.....	9.2	8.444	.....	12.95	8.36	8.61
(316) Misc. plant equipt.	1.58	0.97	1.23	4.40	0.56	0.17	0.84	1.77	2.21	.....	3.3	0.820	.....	1.44	1.16	2.27
Total station	142.21	171.23	121.18	168.10	140.62	126.24	97.56	129.94	102.08	.....	†††163.4	104.129	.....	170.55	96.01	104.86
Outdoor switchyard	12.79	9.26	9.32	9.50	8.68	4.57	9.80	9.36	9.17	.....	14.9	6.595	.....	11.18	6.82	13.61
Total, station and switchyard	155.00	180.49	130.50	177.60	149.30	130.81	107.36	139.30	111.25	.....	178.3	110.724	.....	181.73	102.83	118.47
Building	.....	31.22	12.61	29.20	38.18	25.86	.....	14.80	11.47	.....	40.8	14.082	.....	.....	19.17	.....
Condensing supply works	.....	10.60	5.32	10.80	4.54	2.54	.....	10.90	7.35	.....	0.8	10.006	.....	.....	2.95	.....
Fuel handling	.....	18.71	}	6.60	4.78	4.09	.....	10.48	.....	.....	6.2	1.205	.....	.....	.....	.....
Ash handling	.....	8.44	10.55	0.50	0.81	2.11	.....	1.23	.....	.....	1.6	.....	.....	.....	.....	.....
Draft system	.....	6.93	3.31	3.00	3.33	11.92	.....	4.40	0.97	.....	3.4	1.208	.....	.....	2.23	.....
Feedwater system	.....	9.58	0.25	6.30	4.30	4.48	.....	4.70	4.41	.....	5.5	3.653	.....	.....	4.35	.....
Piping system	.....	11.61	8.45	14.50	10.22	9.55	.....	15.04	7.02	.....	14.3	6.750	.....	.....	9.50	.....
Condensers	.....	4.22	3.56	5.70	3.52	3.13	.....	7.07	7.64	.....	5.3	4.901	.....	.....	4.40	.....
Switchgear, station wiring	.....	10.97	7.34	10.70	5.40	6.73	.....	7.36	.....	.....	9.1	7.16	.....	.....	7.61	.....
Cost of Energy (Mills per NET kwhr)																
Fixed charges at 15%	3.13	7.05	2.65	5.60	.....	2.467	2.489	4.72	6.41	.....	3.48	2.57	.....	3.3	1.95	2.472
Production charges (Table I)	4.02	4.70	4.13	2.9	.....	3.773	1.041	4.63	1.65	4.347	2.44	2.44	4.477	1.24	2.05	1.047
Total	7.15	11.75	6.78	8.56	.....	6.240	3.530	9.35	8.06	.....	6.92	5.01	.....	5.54	4.00	3.519
Station Performance 1950																
Billions Btu used	4,881.9	4,530.6	6,451.2	1,707	5,758	8,175	7,174.9	4,224.3	2,104.1	4,876	5,550	2,586.4	4,102.6	5,900	5,077.6	4,510
Fuel cost, ¢/million Btu	28.2	34.66	33.3	17.6	25.4	28.54	3.53	31.3	8.41	24.9	16	12.5	32.3	5	11.8	6.20
Btu/NET kwhr send out	11,801	11,110	11,121	11,760	11,223	11,424	13,329	11,934	12,209	12,720	11,516	12,931	11,781	13,700	12,795	11,613
Btu/GROSS kwhr generated	11,221	10,529	10,527	10,620	10,532	10,887	12,774	11,213	11,580	11,900	10,940	12,175	11,131	12,960	12,351	11,190
Aver. boiler efficiency (%)	87.7	89.03	87.8	87	87.71	84.5	82.8	88.7	80.7	86.3	89	81.5	86.65	86.4	80.2	87.9
Station thermal efficiency, NET (%)	28.9	30.7	30.7	29	30.43	29.87	25.6	28.6	28.0	26.8	30.6	26.39	28.97	24.9	26.7	29.4
Employees per 1000 Kw per day	0.75	0.454	0.37	0.65	0.31	†††0.55	1.4	0.82	.....	0.98	1.08	0.968	0.64	0.762	1.00	.....
Plant factor, annual (%)	55.2	75.43	100.1	70	78.0	98.0	81.94	68.3	.....	91.7	97	80.8	72.93	98.7	104	115
Utilization factor, annual (%)	122.2	128.9	122.7	113	120.0	115.6	122.8	127.0	119.5	140.0	123	119.7	115.4	112.8	111	144
Station Space Factors																
Boiler room (cu. ft./kw)	4.93	0.69	††1.10	5.2	††13.54	20.5	13.7	0D	.....	13.2	17.60	0.15	19.35	.....	14.5	.....
Turbine room (cu. ft./kw)	6.10	4.34	0.43	7.2	15.40	9.6	10.83	0D	4.73	19.2	7.15	1.5	11.98	0.0656	14.5	5.28
Switch house (cu. ft./kw)	0.22	0.42	.....	.....	1.02	0.42	0.346	0.22	.....	.....	.....	.....	0	.....	0	.....
Office, employee areas (cu. ft./kw)	0.52	0.85	0.22	0.5	.....	.....	0.85	0.31	0.43	0.348	0.36	0.1	0.23	0.125	1.3	0.25
Bldg., ground area (sq. ft./kw)	0.43	0.35	0.1125	0.29	.....	0.366	4.9	0.44	0.19	0.345	0.40	0.3	0.458	0.1385	.....	0.251
Switchyard (sq. ft./kw)	0.27	0.13	0.522	0.52	.....	.....	0.346	1.03	0.85	0.219	0.55	0.3	2.2	0.785	0.7	1.24
Fuel storage area (sq. ft./kw)	3.12	2.18	2.78	2.72	.....	.....	0.565	1.27	.....	1.36	2.3	0.25	5.0	0.193	.....	.....
Coal storage (tons/kw)	.....	1.02	0.77	0.98	.....	0.667	.....	.....	.....	1.14	1.6	.....	1.0	.....	0	.....

(1) Normal function: (a) Normal system station; (b) Normal distribution station; (c) Normal transmission station; (d) Normal base load; (e) Standby.

(2) Rating groups, Mw: I, 0 to 19; II, 20–39; III, 40–59; IV, 60–74; V, 75–99; VI, 100–149; VII, 150 plus.

* 4 months; ** Allocated; *** Gross; † Pulverizer housed only; †† Incl. vol. for future unit; ††† Nameplate; ‡ All data on rated Kw.

(Continued on page 105)

TABLE I — Steam Station Equipment Data and Production Costs (1950) — (Concluded)

Station Number	175	176	177	178 (35)	179 (132)	180 (110)	181	182 (13)	183 (133)	184	185 (136)	186	187	188	189	190
Normal function[1]	(a) (c) (d)	(d)	(d)	(a) (c) (d)	(c)	(a) (d)	(f)	(a) (c) (d)	(a)	(a)	(a)	(a)	(d)	(a)	(d)	(d)
Year, initial operation	1948	1949	1947	1946	1950	1942	1949	1946	1949	1947	1948	1948	1947	1949	1949	1949
latest unit	1949	.....	1950	.....	1952	1947	1951	1950	.....	.....	1949	1949	1947	.....	1949	1949
Total gen. rating (nameplate)[2]	III	III	III	II	II	III	II	II	II	II	II	II	II	I	I	I
No. of turbogenerators	2	1	2	1	2	2	2	2	1	1	3	2	1	1	1	1
Total capability rating[3]	III	III	III	III	III	III	III	III	III	III	II	II	II	I	I	I
Range, capab'y. basis(Mw)[3]	III	III	.....	III	I–III	III	I–III	I–II	III	III	.....	II	II	I	I	I
No. of boilers	2	1	2	2	2	4	2	2	1	1	3	2	2	1	1	1
Rating range (M lbs/hr)	480	134–450	230	250	10–220	70–500	75–400	200–235	90–350	90–350	.....	30–120	130	105	100	100
Steam pressure psi	900	875	850	850	925	640	1300	850	850	860	625	875	900	600	600	600
Steam temp. INITIAL superheat (F)	900	925	900	900	905	750	910	900	900	900	825	910	900	825	825	825
Reheat (F)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cooling water range (F)	75–60	77–32	89–43	92–67	76–44	70–30	82–33	94–57	81–32	82–32	88–50	80–32	80–35	85–55	95–50	95–50
Corresponding vacuum(in. Hg)	1–2	1.99–0.47	2.4–0.35	.....	1.47–0.77	1.2–0.9	3.0–1.0	.....	2.14–1.19	2.13–1.09	3–0.8	2.0–0.6	2.2–0.7	2.5–1	2.5–1.0	2.5–1.0
Plant site area (acres)	90.28	52.8	80	22.3	.....	42.25	3.86	14.1	95.59	40	14	15	37.7	30.5	24.88	1.70
In use (acres)	.....	37.5	5	22.3	.....	23.0	3.86	9.0	8	30	10	12	1	10	2.17	1.25
Fuel storage cap., coal (tons)	50,836	75,000	.....	.....	.....	100,000	4,000	.....	20,000	25,000	.....	100,000	30,000	5,000	24,000	6,300
Oil (bbl)	170	1,072	40,000	110,000	57,000	100,000	30,000	55,000	.....	.....	.....	286	25,000	10,000	.....	.....
Gas (M cu. ft.)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Employees, total (24 hours)	74	43	43	43	36	42	44	34	25	26	21	18	45	12	18	19
Operation	46	30	26	22	28	39	34	17	16	16	16	10	27	9	11	12
Maintenance	12	5	12	17	8	3	4	13	4	4	4	4	6	2	3	4
Clerical stores	1	3	5	4	.....	0	2	4	1	2	1	1	3	1	.....	.....
Fuel handling	15	5	.....	.....	.....	0	.....	.....	4	4	.....	3	5	.....	4	3
Guards	0	0	.....	.....	.....	0	4	.....	.....	0	.....	0	4	.....	.....	.....
Station Details																
Car thawer, car dumper	—, √	√, —	—, —	—, —	—, —	√, —	—, —	—, —	√, —	√, —	—, —	√, —	—, —	—, —	—, —	—, —
Pulverizers, stokers	√, —	√, —	√, —	—, —	√, —	—, √	√, —	√, —	√, —	√, —	—, —	√, —	√, —	—, √	—, √	—, √
Unit plant, boiler header	√, —	√, —	√, —	—, √	√, —	—, √	√, √	√, —	√, —	√, —	—, —	—, √	—, √	√, —	√, —	√, —
Outdoor boiler, outdoor fans	√, √	√, √	—, —	√, √	√, √	—, —	√, √	—, —	—, —	—, —	√, √	—, —	—, —	—, —	—, —	—, —
Fan couplings: H(ydr), E(lec)	H, —	H, —	—, —	—, —	—, —	—, —	—, —	—, —	—, —	—, —	H, —	H, —	—, —	H, —	H, —	H, —
Spray pond, cooling tower	—, —	—, —	—, —	—, —	—, lake	—, —	—, —	—, —	—, —	—, —	—, —	—, —	—, —	—, √	—, √	—, √
Flyash coll.: M(ech), E(lec)	—, E	—, E	—, —	M, —	—, —	M, —	—, E	M, —	M, —	—, E	—, —	—, —	—, E	M, —	M, —	M, —
Centr. control, isol. phase bus	—, —	—, √	—, —	—, —	√, —	—, —	√, √	—, —	√, —	—, —	√, —	—, —	—, √	—, —	—, —	—, —
Fuel Consumption Data																
Coal, (short tons)	118,012	144,968	.....	.....	.....	.....	1,315.8	.....	109,113	112,980	.....	84,833	52,068	25,578.7	34,680	3,350
Btu/lb	12,495	12,847	.....	.....	.....	.....	13,698	.....	11,790	12,630	.....	10,600	13,011	12,000	10,000	11,500
Ash (%), moisture (%)	10; 9	.....	.....	.....	.....	.....	7.88; 3.33	.....	18.57; 2.88	12.27; 3.17	.....	9; 15	10.6; 3.7	8.6; 8.7	14.0; 13.5	9; 12
Cost, ¢/million Btu	34	34.9	.....	.....	.....	.....	32.7	.....	25.4	27	.....	29.08	31.14	26.02	35.25	36.55
Oil (bbl)	573	7,900	550,116	485,663	1,149	507,760	249,440	247,305	.....	.....	.....	477	107,419	.....	.....	.....
Btu/gal	.....	140,850	150,318	151,710	142,857	148,908	149,211	152,549	.....	.....	.....	45,000	149,078	.....	.....	.....
Cost, ¢/million Btu	.....	63.7	33.8	30.3	38.2	33	34.1	32.0	.....	.....	.....	73.4	32.53	.....	.....	.....
Gas (M cu. ft.)	.....	.....	.....	.....	1,152,637	.....	.....	.....	.....	.....	1,189,743	.....	.....	.....	.....	667,183
Btu/cu. ft.	.....	.....	.....	.....	1,234	.....	.....	.....	.....	.....	1,235	.....	.....	.....	.....	1,000
Cost, ¢/million Btu	.....	.....	.....	.....	8.44	.....	.....	.....	.....	.....	5.85	.....	.....	.....	.....	20.83
Output Data																
Total gross gen. (millions kwhr)	266.5	350.64	292.2	280.2	120.4	240.5	142.0	136.5	200.2	232.1	117.489	146.74	173.3	41.45	51.59	55.57
Total net gen. (millions kwhr)	248.3	331.82	280.5	266.6	114.6	227.6	138.6	128.0	184.3	221.9	111.403	137.09	163.9	37.5	46.43	51.07
Maximum 1-hr peak (Mw)	52	49	50	49.7	44.5	44	39	41	37.6	39.3	26	30.5	26.4	8.5	9	8.2
Hours operation 1950	8,758.6	8,626	7,569	8,541	4,532.9	6,917	8,760	8,744.9	7,840	8,660	8,760	8,760	7,956	8,511	8,241	8,168
Operating Costs (Mills per NET kwhr)																
Fuel	4.067	4.00	4.19	3.52	1.07	4.600	3.931	3.96	3.531	3.47	0.777	3.77	3.91	4.26	5.26	3.29
Wages and superintendence	0.914	0.80	0.4	0.43	0.66	0.65	0.870	0.76	0.432	0.355	0.567	0.30	1.12	1.12	0.92	0.77
Water, lubrication, supplies	0.016	0.08	0.1	0.06	.....	0.0272	0.360	0.08	0.046	0.018	0.103	0.05	0.13	0.08	0.38	0.33
Maintenance, repairs																
Buildings and structures	0.017	.....	0.003	0.03	.....	0.0486	0.020	0.06	0.00334	0.00069	0.0129	0.005	0.08	0.001	0.07	0.06
Boiler plant	0.139	.....	0.12	0.13	.....	0.0603	0.302	0.15	0.00150	0.00026	0.0610	0.044	0.03	0.084	0.11	0.11
Fuel handling	0.056	.....	.....	.....	.....	0.0252	0.003	.....	0.09880	0.03160	.....	0.071	0.08	0.032	0.14	0.03
Prime movers and aux	0.048	.....	0.04	0.09	.....	0.0495	0.051	0.13	0.00102	0.00080	0.0888	0.072	0.04	0.045	0.02	0.03
Electrical equipment	0.021	.....	0.01	0.01	.....	0.0064	0.094	0.01	0.00053	0.00011	0.0625	0.024	0.01	0.015	0.03	0.04
Supervision, engrg., misc	0.095	.....	0.03	0.05	.....	0.0060	0.006	0.07	0.02381	0.00266	0.0432	0.034	0.02	0.080	0.08	0.08
Total maintenance	0.376	0.02	0.23	0.31	0.3	0.196	0.476	0.42	0.126	0.036	0.265	0.25	0.46	0.26	0.45	0.34
Total oper. and maint. (excl. fuel)	1.306	0.90	0.75	0.80	0.96	0.8732	1.706	1.26	0.604	0.409	0.935	0.60	1.71	1.46	1.75	1.44
Total production (incl. fuel)	5.373	4.90	4.85	4.32	2.03	5.4732	5.637	5.22	4.135	3.879	1.712	4.37	5.62	5.72	7.01	4.71

TABLE II — Steam Station Unit Investment Cost, Total Power Cost and Performance (1950) — (Concluded)

Station Number	175	176	177	178 (35)	179 (132)	180 (110)	181	182 (13)	183 (133)	184	185 (136)	186	187	188	189	190
Investment Data (Dollars per kw of capability)																
(310) Land	0.735	8.25	2.31	3.06	15.91	1.26	1.632	1.50	1.12	0	0.74	0.35	8.04	1.78	1.46	3.43
(311) Structures, improvements	37.30	59.59	27.25	37.99	52.30	50.00	43.04	35.59	61.25	29.1	13.50	48.31	88.10	68.49	77.90	68.80
(312) Boiler plant equipment	50.00	72.03	35.66	32.38	46.58	46.60	64.64	48.21	44.10	34.3	39.20	55.89	63.35	89.20	98.30	97.75
(314) Turbogenerator unit	32.90	39.07	39.24	19.17	38.21	38.30	39.44	38.25	25.90	17.6	39.30	46.95	35.54	63.36	82.20	82.20
(315) Accessory elec. equipt.	10.80	11.35	10.00	6.43	13.13	.....	26.64	10.15	11.95	5.7	9.60	9.66	21.91	19.30	23.60	20.80
(316) Misc. plant equipt.	1.54	3.54	6.99	2.03	2.85	1.01	0.82	1.43	1.97	0.4	1.60	1.19	3.40	1.21	8.82	1.64
Total station	133.28	193.83	115.45	101.06	168.98	137.17	176.21	135.13	146.29	87.1	103.94	162.25	220.34	243.34	294.00	274.50
Outdoor switchyard	10.50	7.30	7.26	6.31	15.26	11.52	.....	8.33	4.14	2.4	8.35	10.98	12.80	21.27	6.10	19.08
Total, station and switchyard	143.78	201.13	122.71	107.37	184.24	148.69	176.21	143.66	150.43	89.5	112.29	173.23	233.14	264.61	300.10	293.58
Building	22.40	46.80	22.55	.....	.....	.....	23.20	19.03	56.8	26.4	10.3	.....	78.98	.....	.....	.....
Condensing supply works	9.80	12.75	2.66	.....	.....	.....	71.12	7.43	2.3	3.0	5.77	.....	1.44	.....	.....	.....
Fuel handling	7.30	15.10	2.38	.....	.....	.....	9.79	17.00	6.2	4.4	.....	.....	21.92	.....	.....	.....
Ash handling	2.20	5.82	.....	.....	.....	.....	3.11	1.17	2.2	1.2	.....	.....	1.55	.....	.....	.....
Draft system	5.70	5.74	2.40	.....	.....	.....	7.30	4.40	3.5	6.0	2.13	.....	4.16	.....	.....	.....
Feedwater system	3.40	6.57	3.62	.....	.....	.....	5.27	5.55	4.3	2.9	5.6	.....	4.18	.....	.....	.....
Piping system	7.30	12.33	9.99	.....	.....	.....	9.87	10.63	7.3	5.3	14.5	.....	18.72	.....	.....	.....
Condensers	5.00	3.74	4.15	.....	.....	.....	4.73	5.67	3.8	2.2	5.8	.....	3.63	.....	.....	.....
Switchgear, station wiring	6.90	.....	8.57	.....	.....	.....	26.64	9.44	6.0	5.4	5.7	.....	17.52	.....	.....	.....
Cost of Energy (Mills per NET kwhr)																
Fixed charges at 15%	4.18	4.18	3.28	3.02	5.35	4.31	5.78	3.35	4.9	2.4	4.74	5.33	5.33	8.99	7.99	7.12
Production charges (Table I)	5.017	4.90	4.85	4.32	2.03	5.47	5.64	5.22	4.135	3.9	1.71	4.37	5.62	5.72	7.01	4.71
Total	9.197	9.08	8.13	7.34	7.38	9.78	11.42	8.57	9.035	6.3	6.45	9.7	10.95	14.71	15.00	11.83
Station Performance 1950																
Billions Btu used	2,950	3,724.7	3,473	3,094.6	1,428.8	3,180	1,599.3	1,584.5	2,570	2,848	1,470	1,756.7	2,027.4	613.9	693.6	744.2
Fuel cost, ¢/million Btu	34	35.6	33.8	30.3	10.42	33	34	32	25.4	27	5.85	29.42	32.06	26.02	35.23	22.46
Btu/NET kwhr send out	11,878	11,366	12,383	11,606	12,470	13,950	11,550	12,381	13,940	12,857	13,175	12,814	12,382	16,371	14,940	14,573
Btu/GROSS kwhr generated	11,080	10,718	11,885	11,046	11,840	13,220	11,260	11,609	12,830	12,240	12,500	11,970	11,690	14,810	13,445	13,394
Aver. boiler efficiency (%)	80	.....	83	89	85.5	87.78	89	88.7	84.35	85.04	.....	82.9	88.37	85.5	83.5	81.5
Station thermal efficiency, NET (%)	26	30.1	27.5	29.4	27.4	24.46	29.43	27.6	24.56	26.54	25.9	26.6	27.56	20.84	22.8	23.4
Employees per 1000 Kw per day	1.65	0.935	0.86	0.86	0.772	0.773	1.26	0.81	0.625	0.65	0.84	0.60	1.8	1.41	0.46	0.43
Plant Factor, annual (%)	63	95.6	94	93.7	.....	68.63	46.3	50.3	78.4	85.2	53.6	63	79	63.2	78.5	84.6
Utilization Factor, annual (%)	115.5	122.5	100	147.7	118.7	110	111.4	138.7	128.3	132	121	115	105	122.7	120.0	109.3
Station Space Factors																
Boiler room (cu. ft./kw)	4.1	26.72	9.54	OD	.....	26.8	23.84	OD	19.8	33.2	15.8	16	.....	31.8	37.8	37.8
Turbine room (cu. ft./kw)	7.8	17.46	7.29	1.36	0.00655	17.6	9.44	OD	11.2	5.5	)	7	.....	12.4	13.4	13.4
Switch house (cu. ft./kw)	0.85	1.03	0	0.34	.....	.....	5.28	0.24	1.7	0.9	.....	Incl.	.....	0.54	.....	.....
Office, employee areas (cu. ft./kw)	1.5	2.25	1.11	0.55	0.148	0.123	0.24	0.57	1.6	0.54	1.3	1	.....	0	1.1	1.1
Bldg. ground area (sq. ft./kw)	0.9	0.50	4.36	0.33	0.136	0.745	0.51	0.64	0.43	18.5	16	0.44	.....	1.22	1.74	1.71
Switchyard (sq. ft./kw)	1.0	0.37	0.226	0.67	1.6	0.71	.....	0.47	0.104	0.0035	0.96	0.95	.....	1.54	0.12	2.37
Fuel storage area (sq. ft./kw)	3.0	3.59	1.08	2.10	0.1895	5.32	2.18	0.71	1.04	0.9	.....	6	.....	1.46	9.7	2.53
Coal storage (tons/kw)	1.13	1.63	.....	.....	.....	2.28	0.091	.....	0.43	0.62	.....	2.25	.....	0.59	2.91	0.76

(1) Normal function: (a) Normal system station; (b) Normal distribution station; (c) Normal transmission station; (d) Normal base load; (e) Standby.

(2) Rating groups, Mw: I, 0 to 19, II, 20–39; III, 40–59; IV, 60–74; V, 75–99; VI, 100–149; VII, 150 plus.

Designs Geared to Performance

Appreciable improvement in thermal efficiency. Little change in favored pressures and temperatures. Maintenance takes ¼-mill per kilowatthour

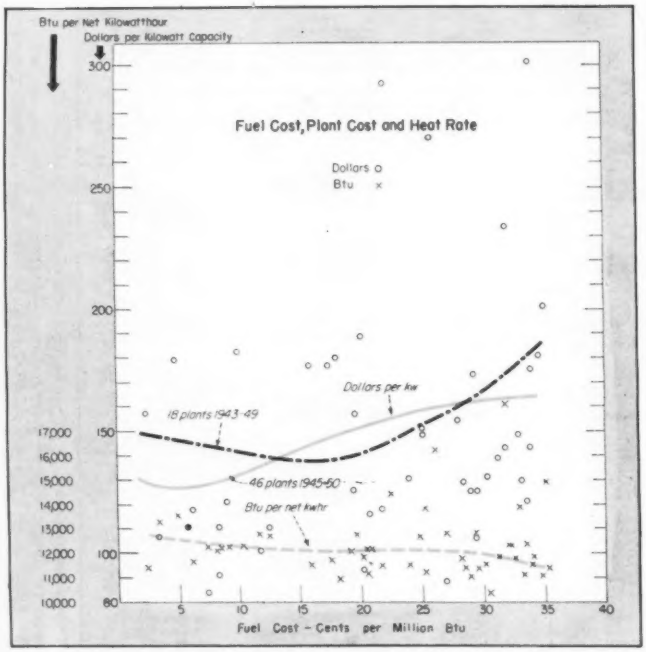


FIG 3—HIGH FUEL COST PLANTS have more spent on them to achieve the higher thermal efficiency desirable for economical operation than do low cost fuel plants

Cost of fuel shows up definitely as a determinant of station design. The cost of fuel ranged from 3.5 to 35 cents per million Btu during 1950. The corresponding plant investments reflect a very wide spread—all the way from $83 to $300 per kw of station capability. With such scattering of points a trend line can only be approximate. As drawn it shows a range of $130 to $165 per kw of capability. If it were permissible to ignore seven unit costs above $175 per kw, the trend line could hold an even $135 for practically any fuel cost. The higher costs per kw are generally associated with higher cost of fuel per useful Btu.

Btu Efficiency . . . Station performance falls between limits of 10,900 and 16,300 Btu per kwhr but the trend line narrows to 11,500-13,000 Btu. Taking the two curves (Fig 3) together, it appears that 27% more is expended per kw to achieve 11% less fuel consumption per kwhr. The largest plants in general show the best efficiencies (Figs 3 and 5) without costing appreciably more per kw.

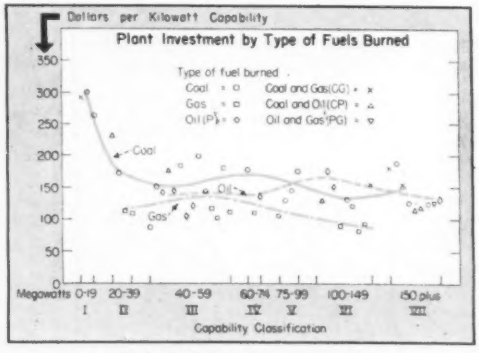

Dollars per Kilowatt Capability
Plant Investment by Type of Fuels Burned
Type of fuel burned
Coal ○ Coal and Gas (CG) ×
Gas □ Coal and Oil (CP) △
Oil (P) ◇ Oil and Gas (PG) ▽
Coal
Oil
Gas
Megawatts 0-19 20-39 40-59 60-74 75-99 100-149 150 plus
I II III IV V VI VII
Capability Classification

FIG 4—COAL-BURNING PLANTS average $150 per kw of capability, oil-burning plants about $145, and gas-burning plants about $125. The latter gain by omission of expense for equipment necessary to the proper handling of fuel and ash

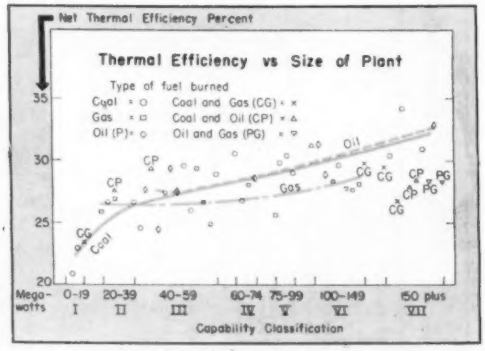

Net Thermal Efficiency Percent
Thermal Efficiency vs Size of Plant
Type of fuel burned
Coal ○ Coal and Gas (CG) ×
Gas □ Coal and Oil (CP) △
Oil (P) ◇ Oil and Gas (PG) ▽
Coal
Oil
Gas
Mega-watts 0-19 20-39 40-59 60-74 75-99 100-149 150 plus
I II III IV V VI VII
Capability Classification

FIG 5—BETTER THERMAL PERFORMANCE is attained by large coal- and oil-burning plants. Compromise in design to burn alternative fuels appears to entail sacrifice of thermal efficiency while gaining the advantages of flexible operations

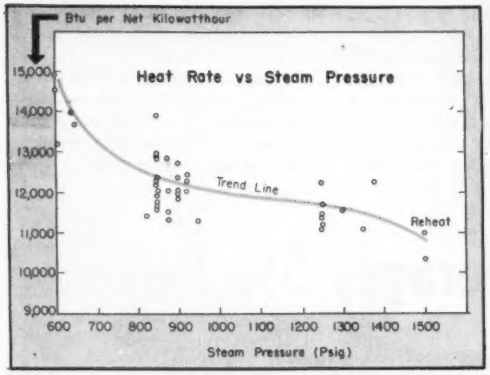


FIG 6—BTU CONSUMPTION per kwhr is naturally less at high pressures (and temperatures) used in the newest plants

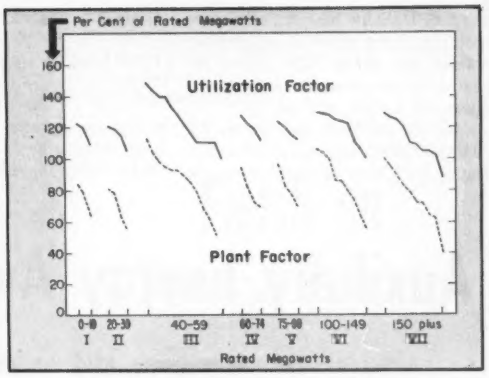


FIG 8—CAPACITY USE is at high level. Peak loads are 15-20% higher than ratings. Plant factors average 75-80%

Plants that burn coal or oil cost about the same per kw (Fig 4) and this is more than for those using gas as fuel. In the case of coal there is the matter of storage, handling, pulverizing, and preheating as well as the cost of ash collection and disposal. This naturally increases costs for such plants but even then those burning oil solely or primarily have as much spent on them as on the coal plants. Presumably this is done to get higher efficiency out of the premium fuel. Larger plants attain higher thermal efficiency than smaller ones (Fig 5).

Steam Conditions . . . Resort to higher steam pressures and temperatures is for the purpose of getting better thermal performance and this is borne out by Fig 6. Prevailing pressures remain the 600 psi, 850-900 psi, and 1250 psi brackets. The latter show 1,000 Btu better performance than the middle group which, in turn, is 2,500 Btu better than the 600 psi plants. These facts are reflected in the amounts of kilowatts designed to use the various pressures (Fig 7). Over half the post-

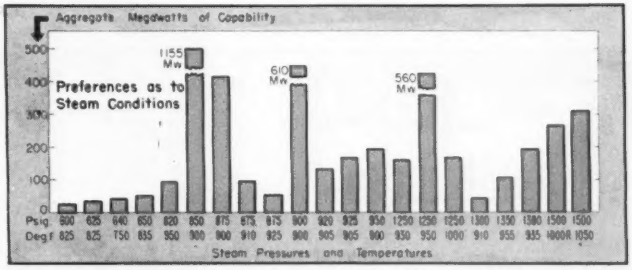


FIG 7—MORE THAN HALF the aggregate capability is in the 820-950 pressure bracket, one-third of the new capacity is in the 1250-1500 psig pressure range

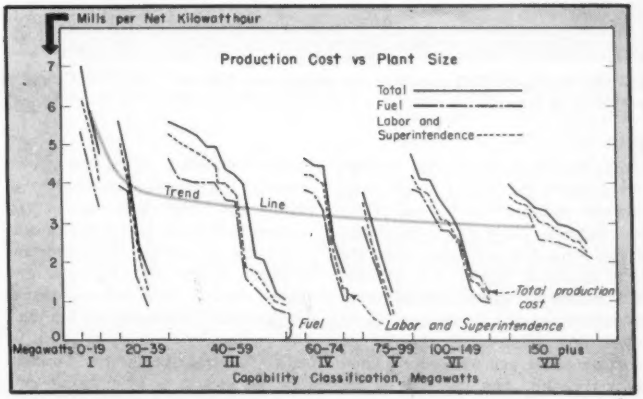


FIG 9—Production cost averages 3.8 to 2.9 mills per kwhr for plants of 20 Mw and above. Fuel represents 75% or more of the total cost of production

Plant Maintenance Cost ⅛ Mill per Kwhr

Maintenance Item	0-19			20-39			40-59			60-74			75-99			100-149			150 and more			All		
Megawatt Group	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.	Min.	Max.	Aver.
Buildings and Structures	0.00	0.07	0.065	0.00	0.08	0.025	0.00	0.06	0.02	0.01	0.06	0.03	0.01	0.04	0.02	0.00	0.03	0.01	0.00	0.07	0.02	0.00	0.08	0.03
Boiler Plant	0.08	0.11	0.10	0.03	0.14	0.07	0.00	0.30	0.12	0.06	0.17	0.09	0.07	0.17	0.12	0.01	0.19	0.08	0.02	0.08	0.06	0.00	0.19	0.09
Fuel Handling	0.03	0.14	0.07	0.07	0.08	0.08	0.00	0.25	0.08	0.03	0.05	0.04	0.00	0.04	0.02	0.00	0.04	0.01	0.01	0.08	0.04	0.00	0.25	0.04
Prime Movers & Aux	0.02	0.04	0.03	0.04	0.13	0.08	0.00	0.13	0.05	0.01	0.12	0.05	0.03	0.16	0.10	0.00	0.04	0.03	0.01	0.08	0.04	0.00	0.16	0.04
Electrical Equipment	0.01	0.04	0.03	0.01	0.06	0.03	0.00	0.09	0.02	0.01	0.04	0.03	0.00	0.10	0.04	0.00	0.02	0.01	0.00	0.01	0.01	0.00	0.10	0.02
Supervision, Engrg Misc	0.08	0.08	0.08	0.02	0.04	0.03	0.01	0.09	0.04	0.02	0.09	0.05	0.02	0.20	0.06	0.01	0.09	0.03	0.00	0.05	0.02	0.01	0.20	0.04
Total Maintenance	0.26	0.45	0.35	0.25	0.46	0.33	0.02	0.48	0.24	0.20	0.96	0.27	0.22	0.36	0.28	0.05	0.37	0.19	0.10	0.29	0.17	0.02	0.48	0.26

war 5,000,000 kw here reported show adoption of the 820-950 psi pressure bracket and about 30% is for the 1250-1500 psi pressures. In terms of plants, 13 are for 850 psi 900F, five are for 900 psi 900F, and five are for 1250 psi 900F. Thirteen plants representing over 30% of the capacity are grouped in the 1250-1500 psi range.

Plant Loading . . . Only one of the 48 plants carried less peak load than its *rated* kw. Twenty percent above rating was common and this considerably exceeds the 14% average excess of capability above rating. Meanwhile the units were loaded so consistently as to accomplish about 80% plant factor.

Production costs averaged (in Fig 9 as in Fig 1) about 3.35 mills per kilowatthour and 2.6 mills of this is for fuel. One-fourth mill went for maintenance (see table on pg 107).

Auxiliary Energy Averages 5½ Percent

Line being held on plant staffing. Station space factors continue improvement. Energy for auxiliary operation mostly from 4 to 9 per cent

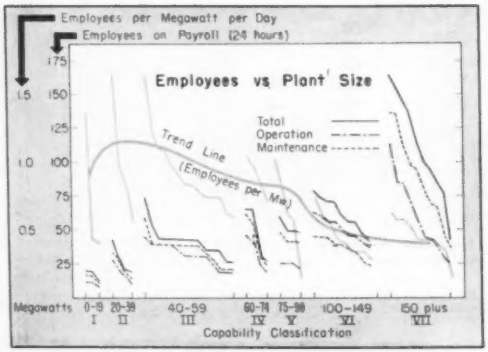


FIG 10—PLANT FORCES amount to one employee per 2 Mw of capability in large plants and one per Mw in smaller plants

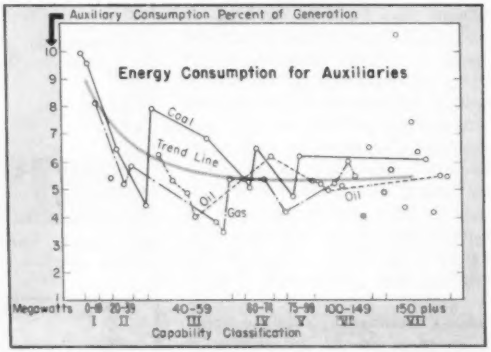


FIG 11—CONSUMPTION of auxiliaries ranges from 3.5 to 10 5% Coal plants average highest, gas least, oil intermediate

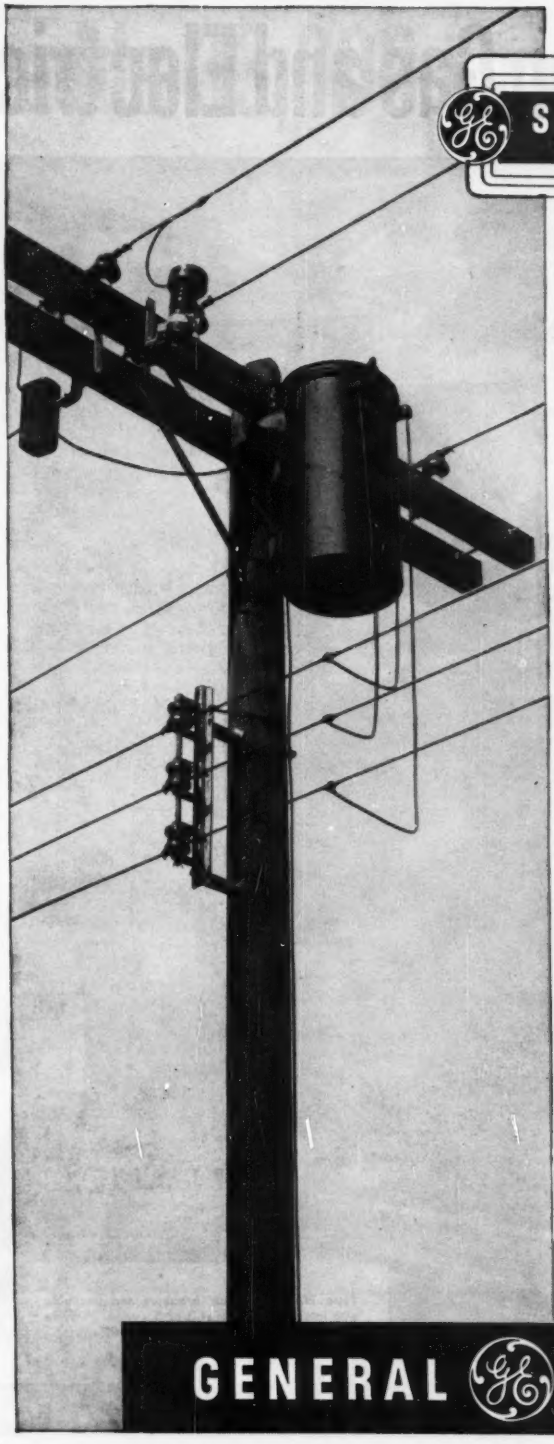
Staff employed during the average day (around the clock) varies from one man per megawatt in small plants to a half-man per mw in large plants. These ratios show no change from the next preceding survey and indicate that designs and dispositions of forces have been stepped up just enough to offset any intervening changes in working hours per week or productivity (Fig 10). Not too clear is the reason why some coal-burning plants in the small and medium brackets require less manpower than gas and oil plants of the same general kw sizes.

Spread from high to low in manpower per Mw is 2 or 3 to 1 in the plants of 100 Mw and above; this appears to offer an excellent opportunity for efforts toward operating with smaller staffs.

Station Volumes . . . Newest plants (omitting the "outdoor" designs) have slightly less boiler room volume per kw than their immediate predecessors, partly due to the trend toward higher pressures where 600 psi was the vogue. Boiler room volume varies widely—from practically nil for outdoor stations to as much as 38 cu ft per kw, general average 18. Turbine areas are as high as 19 cu ft per kw, average 10. Space dedicated to turbogenerators is half that given to boilers; variation runs up to 19 cu ft per kw. Coal storage runs from a half-ton per kw to 1¾ tons with 1.15 tons kept on hand for each kw of capability.

Auxiliary Consumption . . . Values of percentage energy consumption for operation of the station auxiliaries are quite consistent in that the spread for plants of 60 Mw and above is only in a 3 to 2 ratio (Fig 11). Coal burning plants show the highest percentages, as might be expected, but the oil-using plants are not substantially lower despite the avoidance of conveyors, crushers, pulverizers, stokers, ash-handling, etc. Gas-using plants are definitely lower in auxiliary consumption. Dual-fuel operation (parentheses used where one fuel is for minor use other than light-off of burners) seems to conform to the trend for single-fuel plants.

Question can probably be raised about the comparability of the data on boiler room and turbine room volume because some reports undoubtedly include equipment-space items not included by others.



SPIRAKORE TRANSFORMERS

Finish on General Electric Transformers saves one, maybe two, repaintings

San Diego Gas and Electric has been running extensive tests on paint finishes. The Melaglyp paint on General Electric transformers, they say, is superior to any other paint tested. It will save one, maybe two, repaintings.

This is testimony from a company that has in one location almost every condition that is unfavorable to paint: Salt spray. Dry spells during which salt never washes off. Heavy dew. Intense California sunshine.

Melaglyp, a greatly improved paint made with melamine-modified Glyptal* alkyd-resin, has been standard on all G-E Spirakore transformers shipped since 1947. We are confident that you'll find this paint is cutting your maintenance cost.

** Registered trademark of General Electric Company.*

General Electric Company, Schenectady 5, N. Y.

402-110

GENERAL ELECTRIC

Central Hudson Gas and Electric

Type FK-439 oil-blast breakers are available with interrupting time of 3 or 5 cycles, 20-cycle reclosing, interrupting ratings up to 5000 mva . . . voltage ratings 115 to 230 kv.

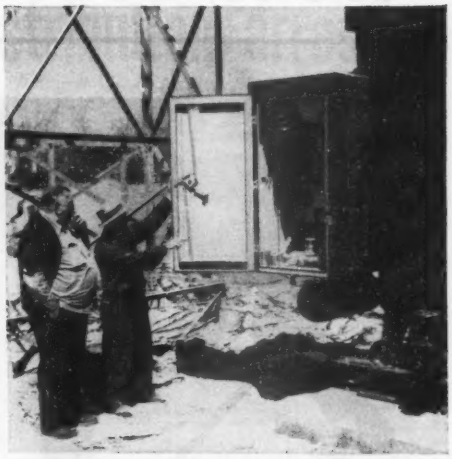
adds 33,000 kva of capacity

Type FK-439 oil-blast breakers protect new 110-kv system

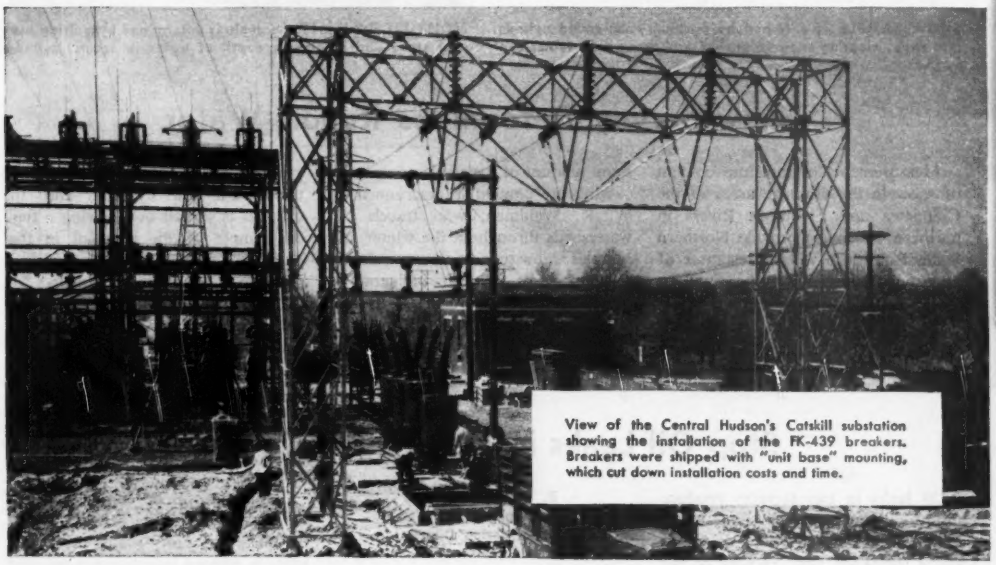
Recently Central Hudson Gas and Electric Corporation embarked on an expansion program to add 33,000 kva of capacity to its Catskill substation. Since plans called for changing high-line voltage from 66-kv to 110-kv, new circuit breaker equipment was necessary.

Company officials chose G-E Type FK-439 oil-blast breakers to protect the new installation. Multi-break interrupters and a dependable pneumatic operating mechanism provide high-speed performance and operating economy. Completely sealed bushings and accessibility of all internal parts simplify inspection and maintenance. Breakers were shipped with "unit base" mounting, which cut down installation time and expense.

Investigate these and the many other economic advantages to be realized when you use G-E switchgear on your system. Ask your G-E sales representative for further information on the FK-439 breaker, or write for Bulletin GEA-4407B, General Electric Company, Schenectady 5, N. Y.



Pneumatic operating mechanism is easily accessible. All working parts have an adequate margin of strength for safety and durability. Thoroughly tested and proved, built for dependable performance and operating economy.



View of the Central Hudson's Catskill substation showing the installation of the FK-439 breakers. Breakers were shipped with "unit base" mounting, which cut down installation costs and time.

GENERAL ELECTRIC

859-13

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN

SNOW SAMPLE is obtained by pushing open-ended cylinder into snow, clearing snow to ground and turning container over

MOISTURE CONTENT of sample is determined by melting snow over stove and measuring depth of water in special cylinder

Snow Survey Determines Runoff Water

Measurements of moisture content of snow in the drainage areas of the Chippewa and Flambeau Rivers in northern Wisconsin provide Northern States Power Co with an estimate of how much runoff water there will be in the spring. This estimate is a reliable guide to operation of the company's dams and hydro plants to prevent floods and to produce the maximum amount of hydro-electric power.

Moisture content is determined by W. K. Weidman, who travels the watersheds throughout the winter and samples snow conditions at suitably selected spots. Depth of snow is measured with a yardstick. Then a graduated cylinder, open at one end, is thrust into the snow. Snow is shoveled away from the cylinder to ground level. The shovel is pushed underneath the cylinder and the cylinder is turned over, giving a typical sample of the snowfall in that particular area. The snow sample is put into a container and melted "on the spot" over a camp stove to assure greatest accuracy. Moisture content is determined by measuring depth to which water fills special container.

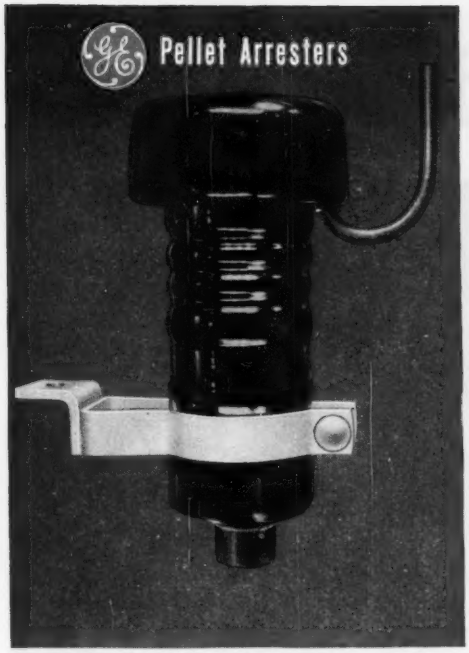
Stop Oil Leaks in Transformer Covers

B. E. ELLSWORTH
Platte Valley Public Power and Irrigation District
North Platte, Neb.

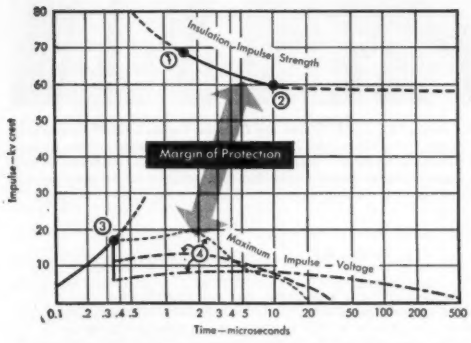
Oil leaks in transformers produce an unsightly and generally undesirable condition. When the trouble is due to gasket shrinkage and cracking of the gasket covering, tightening up the cover bolts will sometimes clear up the situation. But when the bolts are tightened all the way and leakage still persists, these steps should be taken.

Using a solvent, remove all traces of oil and dirt from the transformer cover and find the location of the leak. Leakage around the bolts can be corrected with copper washers. These are put on each end of the bolt and the bolt is tightened snug.

Should the oil be coming through the gasket or seeping between it and the metal, dry putty can be used. The putty is pressed into the crevices and a quick drying paint such as Glyptal is applied immediately, covering the putty and the edge of the gasket. The paint will dry before the putty has become oil soaked and thus form an oil tight seal.



THE G-E PELLET ARRESTER is also unequalled in durability—the only distribution arrester with series gaps sealed in dry, inert nitrogen. Gap electrodes stay bright as new. The Pellets, themselves, are unaffected by service moisture.



THIS GRAPH was made from actual volt-time and ampere-time oscillograms, and from AIEE standard test data. The demonstrated impulse strength of 2400-volt distribution transformer insulation is represented by the curve passing through: (1) the minimum impulse strength on an AIEE standard chopped wave test, and (2) the minimum impulse strength on an AIEE standard full wave test. The impulse voltage allowed by a 3-kv General Electric Pellet Arrester is determined by (3) the impulse sparkover voltage of the arrester on the AIEE standard test wave, and (4) the IR drop across the arrester to ground with (top line) a 65,000 ampere discharge—(middle line) a 20,000 ampere discharge—and (bottom line) a 1500 ampere long duration discharge. The arrows show the unequalled margin of safety.

No other distribution arrester protects so well

HERE'S THE EVIDENCE. The graph below, from actual volt-time and ampere-time oscillograms, shows the unequalled margin of safety that a 3-kv General Electric Pellet Arrester gives a 2400-volt distribution transformer. Higher rated arresters, protecting higher-voltage transformers, similarly show this unequalled margin of protection.

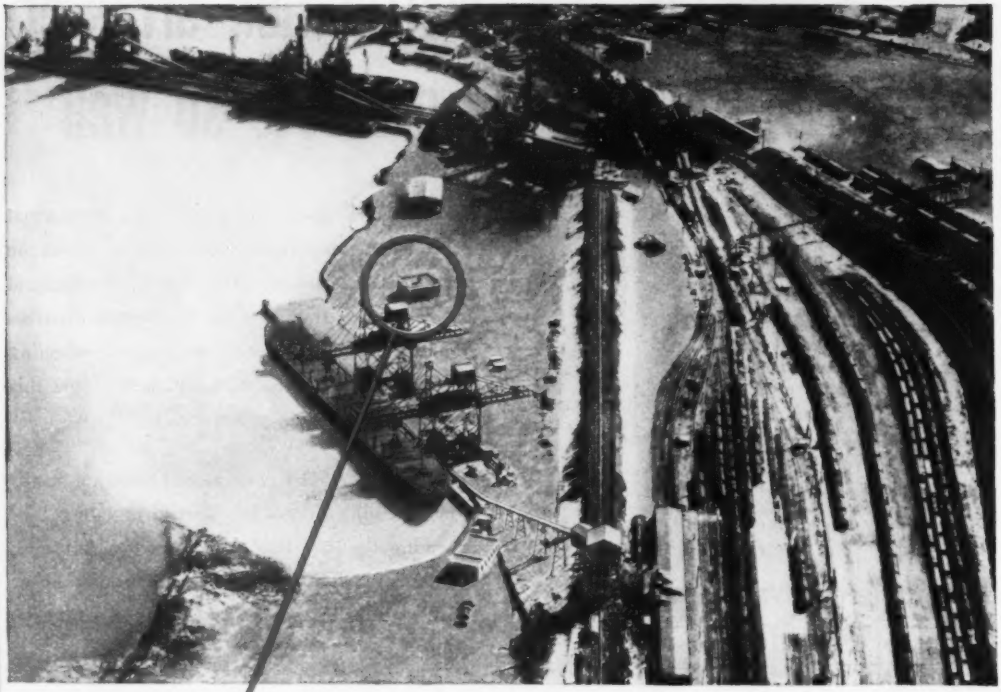
HERE'S THE REASON. This extra protection results from a combination of low sparkover voltage *and* exceptionally low IR drop. Whether lightning currents are high or low, with durations long or short, *no other distribution arrester holds voltages to such low levels.*

HERE'S YOUR CUE. The Pellet is a valve-type arrester for universal use on urban, rural, or industrial systems. It is available in ratings of 1 kv to 15 kv inclusive. This arrester has been *the* quality-standard for over 25 years—it's your cue for maximum protection. For further information contact your G-E representative or your authorized G-E agent.

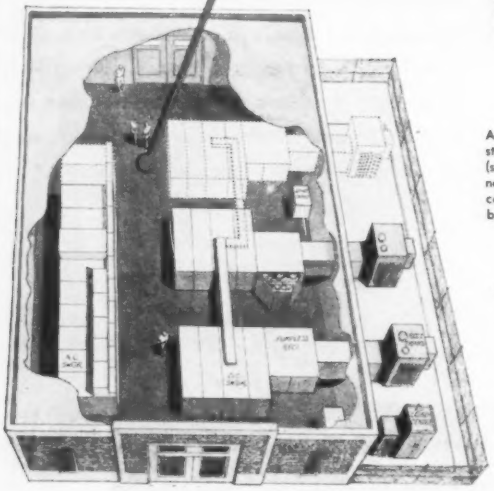
Apparatus Department,
General Electric Company,
Schenectady 5, N. Y.

GENERAL ELECTRIC

G-E switchgear protects operation



Aerial view of the new Baltimore and Ohio ore facility in the Curtis Bay section of the Port of Baltimore. Circled building marks location of the modern G-E substation equipment which supplies power for the two unloaders and two General Electric pusher locomotives that are used to spot gondola cars for loading.



Artist's drawing of the G-E substation showing two 1000 kw d-c substations, a-c substation and metal-clad switchgear. Additional units (sketched in phantom form) show location of the equipment that will be needed for future plans which call for doubling the present unloading capacity. Another d-c load center and two more switchgear units will be needed.

# of new $5,000,000 investment!

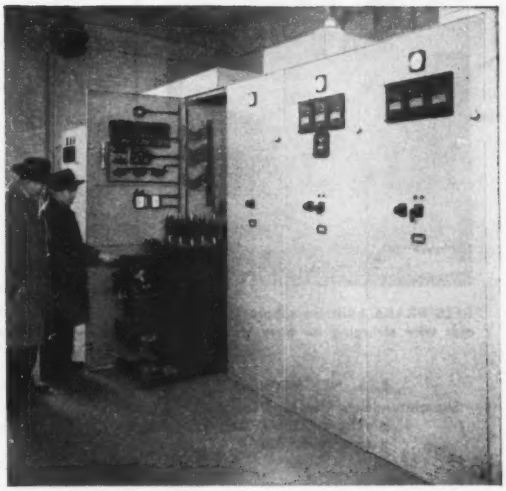
New B&O unloaders move 2000 tons an hour around-the-clock. Continuous power supplied with modern d-c substation and metal-clad switchgear.

Strategic ore from Liberia and South America takes less time to get to the nation's steel producing centers when it is unloaded at the Baltimore and Ohio's new ore facility in the Curtis Bay section of the Port of Baltimore.

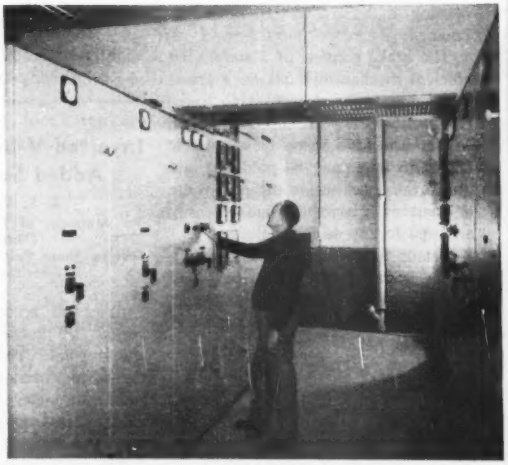
Incorporating the latest improvements in design and equipment, the new ore dock has a working capacity of 2000 tons an hour. The two highly efficient unloaders reduce turn-around time for ore boats and provide an almost continuous stream of ore-laden railroad cars for iron and steel mills. These same cars return to Baltimore loaded with coal, give B & O a two-way pay load for greater efficiency.

Continuous power for 24-hour operation is supplied by modern G-E substations. Two 1000 kw d-c substations supply the main power for the entire installation, while an a-c substation supplies auxiliary power and lighting. G-E metal-clad switchgear provides control and protection for the incoming and outgoing feeders to a-c and d-c load centers.

Forward-looking G-E engineers are ready to apply the knowledge gained from this, and hundreds of other installations, to *your* problems. Investigate today the many advantages of using General Electric switchgear in your plant for efficient, flexible power distribution. Contact your G-E sales representative, or write for bulletin GEA-3083 Metal-clad switchgear. General Electric Company, Schenectady 5, N. Y.



G-E metal-clad switchgear for the 13.2 kv feeders to a-c and d-c substations. All components are metal-enclosed for protection to personnel. Because units are factory-built and arrive ready to install, total installed cost is greatly reduced.



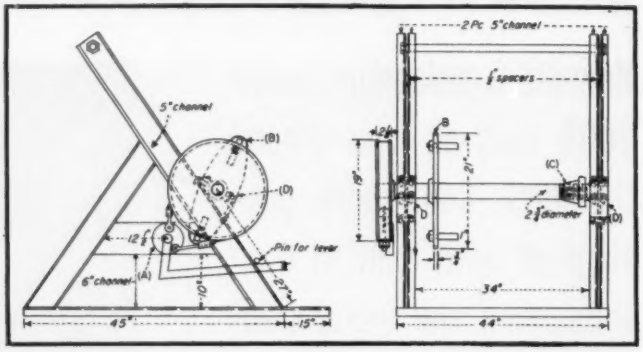
View of the operating aisle of the d-c substation. New G-E pumpless rectifiers provide continuous low-cost d-c power conversion. Minimum number of moving parts reduces maintenance. All parts are easily accessible.

GENERAL ELECTRIC

854-58

Wire-Reel Brake Reduces Stringing Hazards

REEL BRAKE built on supporting frame aids wire stringing on busy streets



CONSTRUCTION DETAILS show welded channel-iron frame support. Equipment may be made in machine shop. Adjustments are easily made for any desired tension

E. S. NEIGHBORS
Superintendent, Electric Department
Birmingham Electric Co
Birmingham, Ala.

The reel brake illustrated permits wire to be strung in urban districts on poles supporting energized circuits. It eliminates sag which could short-circuit or contact energized circuits causing a hazardous condition for linemen.

The brake consists of a simple but efficient mechanism built on a frame that supports the reel. Braking frame and reel assembly are mounted bolted to the bed of a truck or a suitable trailer so wire may be paid out and pulled into position on the pole route at constant tension that can be easily adjusted to any desired value.

Details of construction are shown in an accompanying drawing. The frame is made of channel iron, angle iron, or I-beams of proper length and welded in position. Size of the reel determines dimensions of the frame. Split cast iron bearings (D) can be bolted or welded to the frame, but should be machined to a smooth and reasonably close fit for the shaft.

An appropriate length of 2¾ in. steel shaft that will accommodate the largest reel to be used is secured. Journals are machined to 2½ in. diameter at the proper points. Shaft is keyed to a cast iron brake drum machined to fit the shaft and key way. Outer face of brake drum is machined to fit 2 in. brake band which lines a 2x⅛ in. circular steel band having eye bolts and fittings on the ends of brake band for control and adjustment.

Shaft is threaded 3 to 4 in. to accommodate a nut (C) which may be made cone-shaped for centering reels with larger arbor holes. A flat nut may be used if arbor hole is only slightly larger than the shaft.

Reel driving mechanism (B) may be attached to the shaft by set screws or welding. Driving pins are adjustable to the driving pin holes in the reel. One or two pins may be used.

This complete shaft assembly is placed in the reel before it, with braking shaft attached, is hoisted into the frame bearings.

The brake band is removed from the drum by raising the braking lever to loosen the band and slipping one eye off the pin on the assembly (A). The brake band is laid over to the side while reel is changed.

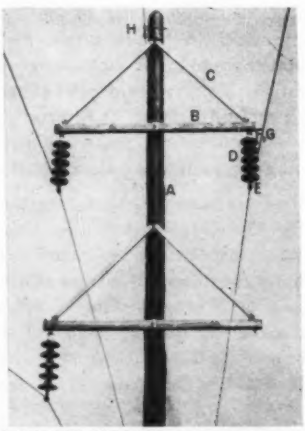
Inverted V-Brace Gives Added Support to Arms

E. S. MORTIMER
Manager of Transmission and Distribution
Eastern Shore Public Service Co of Md
Salisbury, Md.

Crossarm braces placed in an inverted "V" position are being used on a 69-kv line. This type of construction is employed on tangent runs and runs with angles less than 7 deg. Duplicate arm-and-brace units are required for carrying 3 conductors.

The wood braces are pivoted above and extend down to top of the crossarm where the insulator strings are attached. This arrangement provides support at the points of greatest load on the crossarms.

The arm-and-brace units are usually used on 50 ft poles which are set 7.5 ft deep, and on 60 and 65-ft poles which are set 8 ft deep.



INVERTED V-BRACE supports crossarm where load is greatest. Major components are: (A) Yellow pine class 3 pole, (B) 4x5 in. x 10 ft crossarms, (C) braces, (D) insulators, (E) socket eye suspension clamps, (F) ball hooks, (G) shoulder eye bolts, (H) overhead ground wire support

Adapted from paper presented at Engineering and Operation Section Conference of the Southeastern Electric Exchange.

NEW CONSOLE

Speeds dispatching-

Brings control settings to operator's desk

Power interchange and system generation are now regulated with greater speed, efficiency and convenience than ever before, through the latest L&N load-frequency control which features a new remote-control console. In the typical system operator's office shown above, this arrangement brings the control-setting dials from the individual control instruments right up to the operator's desk.

Without leaving his chair, the operator can make all instrument adjustments. For example, he can assign load responsibilities to generating stations, set ratio of load sharing, designate how much power is sent into or out of the system, adjust the high and low load limits and maneuvering point for each regulating station, and change the rate of control response. As he makes these and other changes, he has ample facilities for observing their effect through the graphic instruments on his panel. Because all vital control settings are literally at his finger-tips, he has greater convenience in varying regulation to meet schedules . . . and can keep the entire system in proper balance.

Now regulating over 40,000,000 kilowatts of generating capacity, L&N coordinated load-frequency control and telemetering is designed by our specialists for the needs of each individual system. Tailor-made instrument panels, fully assembled, wired and tested in the L&N shops, are shipped ready to connect to station equipment.

For details, write for Technical Publication ND4-56-461(1). Address Leeds & Northrup Company, 4938 Stenton Avenue, Philadelphia 44, Pa.

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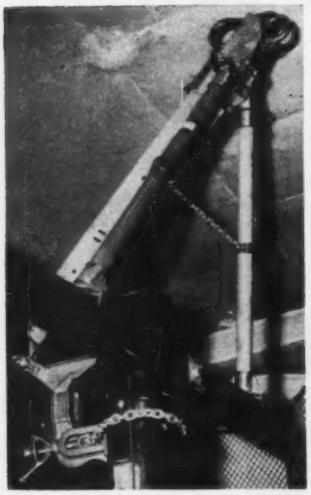
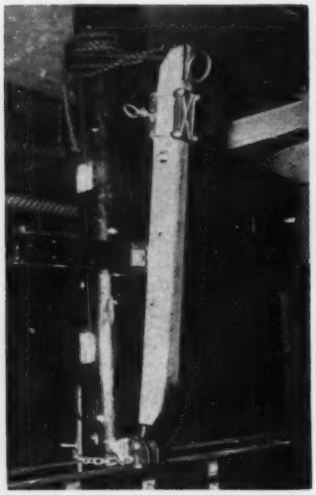
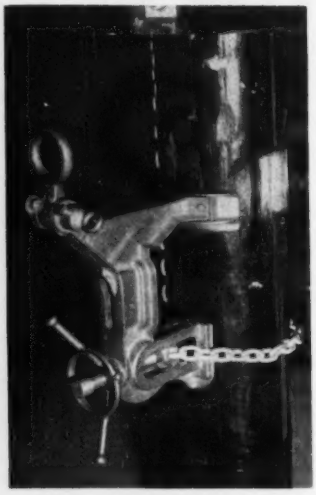
Install Transformers With Lightweight Gins







THREE TRANSFORMER GINS speed up transformer installations on either rack or rural construction on the Commonwealth Edison Co system, according to Walter G. Edelblute, engineer in the overhead division of the construction department. These new tools are lighter than the type used previously and take less time to install. On rack construction, the lightweight gin (left) has capacity to handle a 50-kva transformer with comfortable safety factor. On other types of construction where mounting below pole-top is necessary, the timber boom (center) can be used with a base plate for handling transformers up to and including 100 kva. The simple metal gin (right) has capacity for handling 100-kva transformers

Outriggers Distribute Rotor Load Over Bridge

CLAYTON M. ALLEN

THOMAS H. MULLEN

Dept of Water and Power
Los Angeles, Cal.

To distribute a gross load of 125 tons evenly enough to cross seven small bridges safely, the Los Angeles Department of Water and Power used on a low-bed tractor-trailer combination outriggers riding on rollers supported by double H-beams. The Department was granted permission to move three 90-ton rotors for its Owens Gorge Hydro development only after satisfying state highway authorities that the proposed arrangement would stay within the safe load limit on the bridges.

To relieve the low-bed semi-trailer of a portion of the total load, combination steel and wood outriggers on each side supported an H-beam placed across the bed of the trailer beneath the cradle in which the rotor rested. A calibrated hydraulic jack on each side raised this cross beam until it took the desired amount of load, transferring it to the outrigger and through the rollers to 12-in. H-beams on each side of the road.

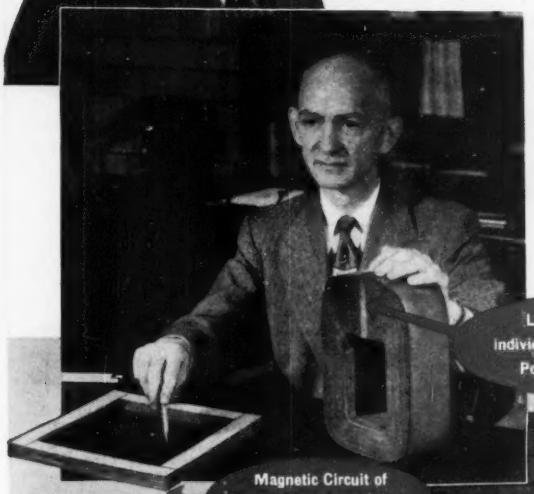
TIMBER-STEEL OUTRIGGERS supporting an H-beam across the trailer bed take 33,000 lb each of a 125-ton gross load as a 90-ton rotor is moved over seven small bridges in a 75-mile trip. Truck-mounted crane (rear) handled the beams

The steel H-beams were handled by a 20-ton, truck-mounted crane which placed them along the roadway and reloaded them on a following truck after the load had passed over bridge. Time required for the 75-mile trip from the railhead to the project site was about eleven hours.

"There are Good Metallurgical and Design Reasons for the Low Exciting Current and Low Core Loss of the POLE STAR"

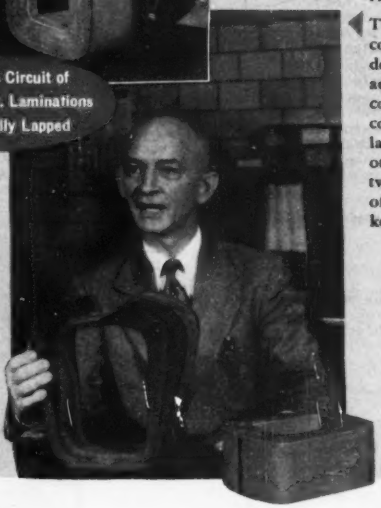
says Clarence J. Witsberger, *Electrical and Metallurgical Engineer*
PENNSYLVANIA TRANSFORMER COMPANY
Member ASTM Committee A6 on Magnetic Properties

Modern distribution transformers are fabricated of preferred oriented grades of cold reduced silicon steels. It is desirable therefore to take full advantage of the high permeability and low loss characteristics of this fine grade steel. This is accomplished in the Pole Star core design.



Laminations individually lapped in Pole Star core

Magnetic Circuit of Epstein Test. Laminations Individually Lapped



Low Reluctance at Lap Joint Results in Low Exciting Current

A minimum reluctance at the joint of the Pole Star Core is achieved by lapping the individual laminations. This is the same type of lap joint used in the magnetic circuit of the latest approved method for testing the permeability of preferred oriented cold reduced silicon steels. This test is known as the 25 cm. Epstein Test for core loss and permeability. The Pole Star core achieves a low exciting current by combining High Permeability Steel with a low reluctance joint.

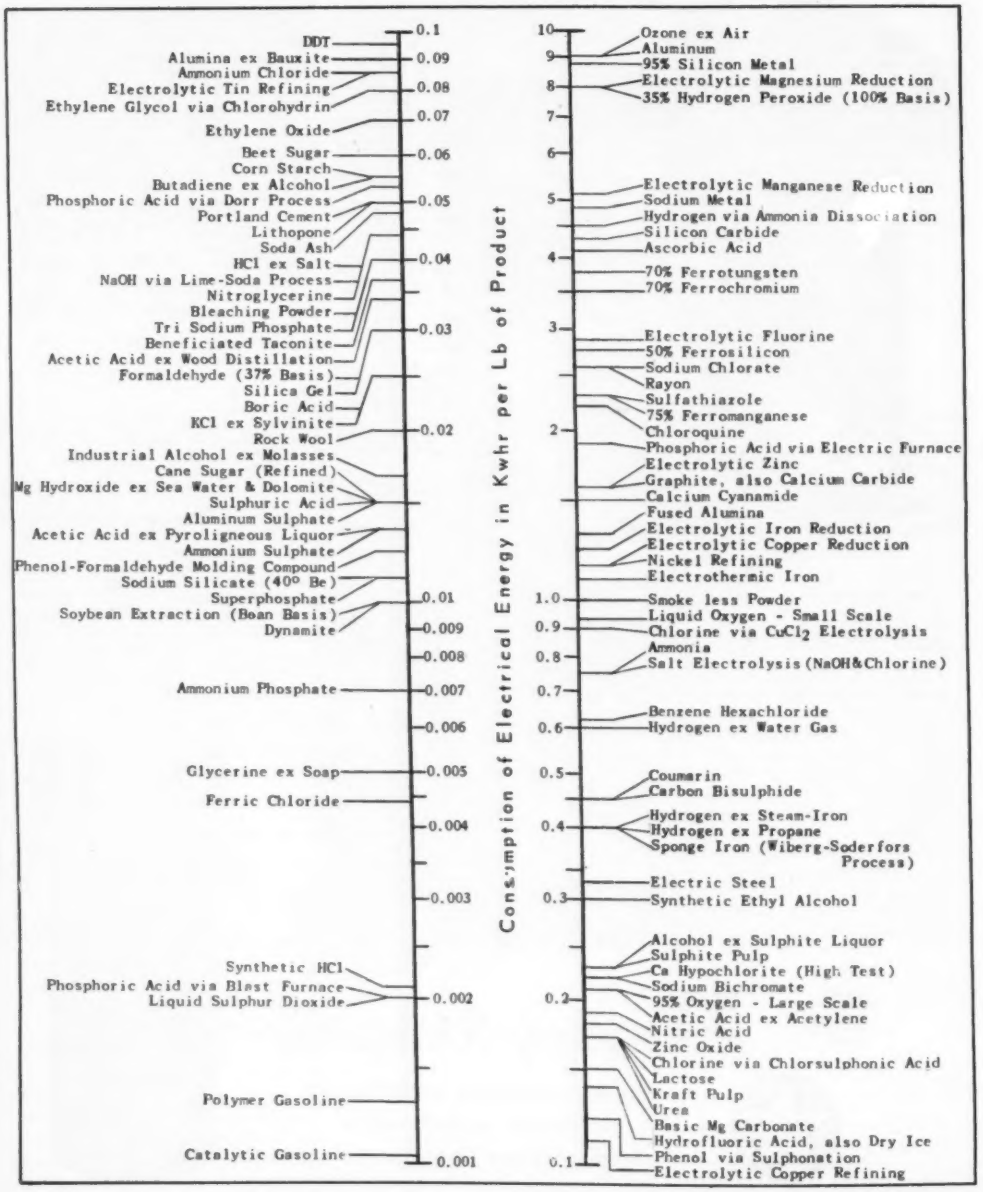
Absence of Adhesions in Core Results in Low Core Loss

The core is carefully annealed in controlled-atmosphere furnaces, but does not suffer the disadvantages of adhesions. That is because in the core assembly process—when the core is built into the coils—the laminations are separated from each other. The absence of adhesions between laminations and the presence of high interlamination resistance keeps the core loss at a low value.

Pennsylvania
TRANSFORMER COMPANY
CANONSBURG, PENNSYLVANIA
Greater Pittsburgh District

Chemical Process Energy Requirements

Chart gives unit figures on electrical energy consumption in the manufacture of over 100 chemical products. Reproduced by courtesy of "Chemical Engineering"



Safest TO WORK HOT

Attachment of an O-B Clamptop insulator to the conductor is made with a compact clamping member compressed by two hex nuts. This member, smaller than a man's fist, is the only charged portion when making a hot stick installation. It is handled by a simple socket wrench that offers a minimum chance of slipping or otherwise going out of control. Final installation is stronger than the best hand-made tie, and permanent . . . Compare this with installing a hot tie. The end of the tie wire describes a large circle through the air, in whose area full line potential exists. The end of this tie wire may snap or spring out of control. And when installed, a weak connection of no real permanence has been made . . . Since hot line construction and maintenance is growing with the demand for power continuity, prepare for doing this faster, better, and safer by building with O-B Clamptop insulators; either conventional pintypes or posts.

Ohio Brass

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4137-M

Bus Sectionalizing Links Reduce Maintenance Expense

J. F. PHELAN
Chief Load Dispatcher, South Bend Div
Indiana & Michigan Electric Co
South Bend, Ind.

Necessity of frequent bus sectionalization may justify disconnect switches. However where sectionalizing is required infrequently to permit large maintenance crews to work without electrical hazards, the method illustrated has advantages.

Sectionalize Low-voltage Buses

On lower-voltage solid buses, removable links (Fig 1) can be inserted which permit a substation bus to be sectionalized and allow either section to be properly cleared for maintenance. This use of removable links is applicable where there are two feed-in lines and transformer banks, or where a mobile substation can serve while normal power supply is interrupted. On one maintenance job $1,640 was saved.

Installation of these links was simple. All that was required was removal of the single bus support insulators, installation of a steel plate for supporting two insulators per phase, then cutting the bus and installing the connectors. This easily removable section of the original bus became the removable link. The whole change was made at a cost of less than $257. Comparable bus-sectionalizing disconnects would have cost at least $700 installed and could not be justified because of the very infrequent need for them. Right here is a saving of $443 for equipment.

Removal or insertion of these links can be accomplished by two men in about one-half hour once the bus has been cleared. This operation does not involve any unusual difficulty and is not costly where required only once in a 4- to 10-year period.

Links Applied to 27-kv Bus

Accompanying illustrations show the removable-link idea applied to 27-kv tubular bus construction at the West Side Substation at South Bend. This station serves an industrial and residential area and has a dual-bus arrangement.

Condition of the steel at West Side switching station required cleaning, spotting, and two finish coats to be applied with at least 24-hr drying intervals between them. Convention methods—removing the station on week-ends—would have required bringing in large outside crews, running up the cost of the job considerably. By cutting the "B" bus and using the removed section as a link, it was possible to do this job during the normal work-week while keeping the station in operation. Because the contractor was able to stay on the job until completed, $1,200 in painting

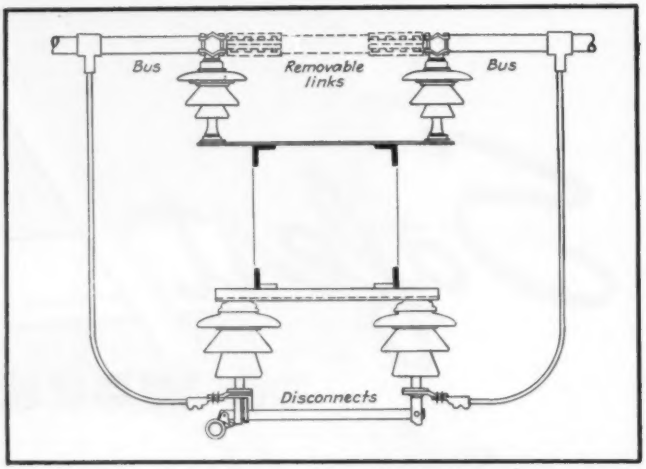

FIG 1—REMOVABLE LINK or disconnect switch may serve for bus sectionalizing to isolate a section of bus in a substation during maintenance operations

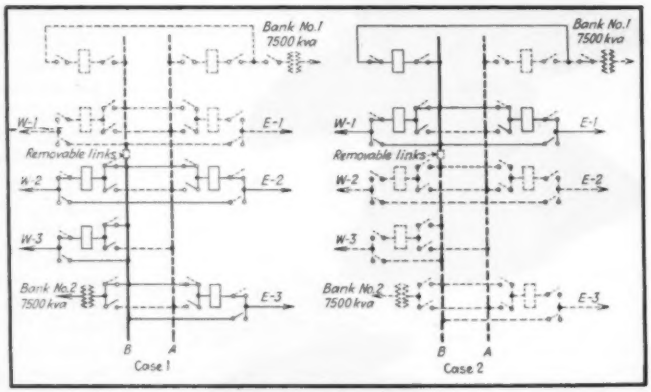

FIG 2—BUS LINKS removed for safety during painting or other maintenance. Clearance of alternate halves of substation permit work of large crews without electrical hazard. Solid lines indicate energized section, dotted lines de-energized section

Comparative Equipment Costs for Sectionalizing a Three-Phase Bus

Removable Links	
3 Galvanized steel plates	$54.00
3 45-kv post type insulators	76.00
6 2 in. straight-thru bus connectors	102.00
Labor	24.50
Total	**$256.50**
Disconnect Switches	
3 Galvanized steel plates	$54.00
3 45-kv post-type insulators	76.00
*2 ft 1,000-Mcm copper cable	40.00
6 2 in. x 1,000 cirmil tee connectors	41.50
6 1,000-cir mil flat connectors	24.00
3 Type FA disconnect switches	300.00
1 Special Switch Stick	25.00
Labor	140.00
Total	**$700.00**

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The FARGO "9000 Series"

THE FARGO "9000A Series"

THE FARGO "9000AC Series"

FARGO engineers have been "thinking ahead" again—designing improved connectors for use with aluminum-to-aluminum or aluminum-to-copper connections.

The family name for these new connectors is the FARGO "9000 Series"—with the closely related "9000A and 9000AC Series."

First, let's take a look at the distinctive advantages that they all have in common:

1. "One-piece" construction for ease of handling and installation.
2. Jaws designed for a wide range of sizes.
3. Can be used with or without a spacer bar.
4. Long, completely enclosed thread that permits ready salvaging for re-use.
5. Built like a vise . . . grip like a vise.

•

Ask your Line Material Field Engineer to give you further details.

THE "9000 SERIES" FOR ALUMINUM-TO-ALUMINUM CONNECTIONS is of cast aluminum without a spacer bar. It has a plated Duronze bolt and plated bronze washer.

THE "9000A SERIES" FOR ALUMINUM-TO-ALUMINUM CONNECTIONS WHERE A SPACER BAR IS DESIRED is entirely of cast aluminum—except for the plated Duronze bolt and plated bronze washer. Principal reason why the spacer bar is desirable is that it provides extra contact area, distributes pressure more evenly, and prevents crushing or distortion of strands.

THE "9000AC SERIES" FOR ALUMINUM-TO-COPPER CONNECTIONS WHERE SPACER BAR IS REQUIRED employs a female half of cast aluminum and a male half of cast bronze. The spacer bar is of electrolytic copper, with plating removed from the surface on the copper side. Here, the spacer bar provides the same advantages as it does in the "9000A Series"—plus the liberal and desirable spacing of aluminum and copper conductors. The bolt is of Duronze; the washer of plated bronze.

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Distributed by

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(A McGraw Electric Company Division)

Milwaukee, Wisconsin

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From dispatch center in Wichita, orders flow out over RCA radio network to all KGE trucks and cars . . . anywhere in area, day and night.

Field superintendent gets trouble call by radio. Directs field crews to outage while he drives there himself.

Radio-directed crews reach trouble in record time. KGE can cover area with fewer trucks, fewer men . . . thanks to RCA 2-way radio.

How a Kansas Utility

Speeds Up Field Operations

with RCA 2-WAY RADIO

Radio directs 107 trucks and cars all over southeastern Kansas for Kansas Gas and Electric Company. Could <u>your</u> business profit from radio, too? Read answer below . . .

Radio Covers 20,000-Square-Mile Area

Kansas Gas and Electric's system spreads out all the way from Kingman 200 miles east to the state line . . . a big territory crisscrossed with vital power lines . . . a job made to order for RCA 2-way radio coverage.

Gives Faster, Better Service

Eight base radio stations blanket the area with main dispatch headquarters at Wichita. Over this network, calls can reach any truck or auto anywhere in the territory. Result: faster service all along the line, less outage time because radio sends the nearest crew to the trouble. Less lost mileage, less wear and tear. More efficient use of men and equipment. And more reliable communications—especially when telephone lines are knocked down by storms. *It's all typical of what RCA 2-way radio can do in any widely spread-out field operation.*

Could Your Business Use 2-Way Radio?

If you operate far-scattered field crews, RCA 2-way radio can save you time and money in dozens of ways. Puts a "phone" in every truck or car. Operates in all weather. Uses standard tubes. Low operational cost. Easy to install and maintain. Mobile units are compact, lightweight, rugged.

Let RCA Help You . . . Now

RCA helps put radio to work for you. Makes initial study. Helps with FCC permit, installation. And nation-wide RCA Service Company handles installation and service if desired. Find out *now* how 2-way radio can save time and money for *you*. Clip and mail coupon for your FREE 2-way radio booklet . . . *today*.

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RCA **RADIO CORPORATION of AMERICA**

costs were saved for the company.

Here is how the alternate "halves" of the substation buses are cleared:

Case 1. Station supplied by circuits E-2 and W-3. Load supplied over circuits W-2 and E-3. Bank No. 2 supplies distribution. North section of bus B and entire bus A cleared, also E-1 and W-1 lines.

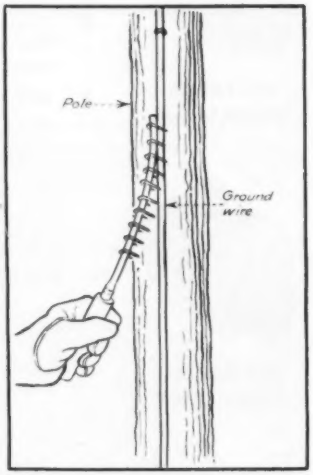
Case 2. Station supplied by circuit E-1. Load supplied over circuit W-1. Bank No. 1 supplies distribution. South section of bus B and entire bus A cleared, aslo E-2, W-2, W-3, and E-3 lines.

Staple Holder Aids Ground Wire Attachment

JOHN L. COLLINS
Plant Engineer
Central Maine Power Co
Augusta, Maine

To overcome the annoyance of dropping staples from a gloved hand when fastening ground wires on wooden poles, a staple carrier was developed by Central Maine Power Co. It consists of a piece of rubber tubing about 12 in. long attached to a handle through which passes an annealed copper wire core. The wire extends from a loop at the end of the handle through the rubber tubing. The wire provides flexibility and a degree of stiffening to the rubber tubing.

In operation, the lineman loads a series of staples along the tube. As each staple is placed at the desired



HOLDER eliminates dropping of staples used to attach ground wire to pole. It also eliminates bruised fingers

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CLASSIFICATIONS

300 kva 500 kva 750 kva 1000 kva

Available in high voltage insulation classes: 5 kv 15 kv 22 kv 33kv

5 kv and lower (taps available at extra cost); 7.2 kv to 33 kv (four 2½% taps below normal); low voltage: 125/216Y, 4 wire.

YOU CAN GAIN important advantages by choosing Allis-Chalmers standard network designs and ratings for these reasons:

1. Standard designs speed production . . . permit more attractive delivery.
2. With mechanical and electrical data immediately available your selection of the right network transformer is made easier.
3. Standard construction and accessory arrangement lends itself to simplified service procedure.

Your application problem is further simplified because Allis-Chalmers builds all three basic types of network transformers in a wide range of standard ratings: oil filled, *Chlorextol* liquid filled and sealed dry type. A-C engineers can make unbiased recommendations for your system. For most installations you eliminate special engineering by selecting from standard designs and ratings.

Take advantage of Allis-Chalmers wide transformer range and experience. Call in an Allis-Chalmers representative early in your network planning stages. Offices in 64 principal cities.

ECONOMY CONSTRUCTION FEATURES

MAIN COVER and switch compartment welded to the tank eliminate large gasket.

TAP CHANGING MECHANISM controls three phases simultaneously. It is operated by removing a 2-inch pipe plug in the main cover and inserting the special wrench held in a bracket adjacent to the sealed entrance. The tap changer handle cannot be removed unless the tap changer is correctly positioned.

UNDERCOATING COMPOUND gives extra protection to base area after the tank surfaces are given 3 coats of baked-on paint to protect them against corrosive atmospheres.

ACCESSORIES are located on the high voltage end of the transformer. Gages are at eye level.

FILTER PRESS VALVES are located together but the system provides cross flow for complete interchange of liquid. Threaded valves are solder wiped for added protection against leaks.

For more information about Allis-Chalmers network transformers contact your local A-C sales office. Or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3460

Chlorextol is an Allis-Chalmers trademark.

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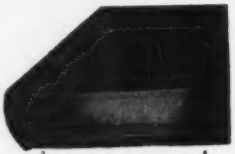

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location on the pole, it is tapped lightly and the holder is withdrawn from it, leaving the staple free for hammering around the ground wire. In practice enough staples can be straddled over the rubber tube to provide for the average length of ground wire run under a crossarm and down the pole.

The annealed wire core can easily be bent at any desired angle. The loop at the end of the handle helps hold the wire core in position. A pin driven through the handle keeps the tube from slipping. Two sizes of tubing are used to take various sizes of staples.

Dry Type Transformer Used On Network System

E. L. LEINBACH
Engineer, Detroit Edison Co

Several dry type, nitrogen filled transformers, with Class H insulation, have been installed on our system and experience with them so far has been favorable. The first dry type unit was installed on the first floor of a company owned building which was undergoing rehabilitation. It has been in operation about a year and has been very satisfactory. Three others have been installed in vaults under the sidewalk next to company's general office building.

In these installations one of the more important problems was that of size. Most of our vaults have been constructed to accept nothing larger than a 500-kva oil-filled transformer. The first dry type proposed was too big to be used as a replacement. Ne-

DRY TYPE 500-kva transformer, designed for vault built to take a 500-kva oil-filled transformer, was a close fit

gotiations with the manufacturer resulted in a 500-kva, dry type unit small enough to go into the existing vault yet with an acceptable temperature rise.

Impulse level of 35 kv, as compared to 75 kv for the oil-filled transformers on the network system, was considered acceptable. There were two reasons for this decision. First, all of the network primary is underground and bus exposure from other overhead circuits is quite limited. Second were the other advantages of the dry type transformer, including its non-inflammable characteristic.

Noise level was guaranteed not to be less than 62 db for the dry type as compared to about 53 db as received for the oil-filled. In the locations involved, noise was not too much of a problem because the vaults are in commercial districts and the vault covers were to be sealed completely.

Top gas temperature at rated load is around 120 C. Because the primary cable is required to come into the top of the tank through wiping sleeves, conventional 5,000-v insulation could not be used. Instead, a silicone rubber insulation which will take temperature up to 250 C was used and appears to be working satisfactorily.

World Aluminum Production
(Thousands of metric tons)

	1946	1947	1948	1949
North America				
United States	371.6	518.7	565.6	547.4
Canada	175.4	271.3	333.0	335.0
Total	547.0	790.0	898.6	882.4
Western Europe				
Austria	1.0	4.5	13.3	14.8
Belgium	.....	.....	.....	2.2
France	48.0	53.2	64.8	54.3
Germany	.....	.....	7.3	36.0
Italy	11.0	25.1	33.1	25.6
Norway	16.4	21.7	30.1	36.0
Spain	1.0	1.0	1.0	0.7
Sweden	3.6	2.9	3.5	4.0
Switzerland	13.1	18.5	19.0	21.0
United Kingdom	32.1	29.4	30.5	30.3
Yugoslavia	.....	.....	.....	1.0
Total	126.2	156.3	209.6	225.9
Russia and Satellite				
Russia	105.0	120.0	140.0	155.0
Hungary	2.0	5.2	5.2	4.0
Total	107.0	125.2	145.2	159.0
Asia				
India	3.2	3.2	3.4	3.3
Japan	3.2	2.7	7.0	17.5
Korea	5.0	5.0	5.0	.....
Formosa	.....	.....	2.5	1.3
Total	11.4	10.9	17.9	22.1
World Total	791.6	1,082.4	1,264.3	1,289.4

Source: "Aluminum, the Industry and the Four North American Producers," courtesy The First Boston Corp.

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You get **Easy Cable Pull,** too. Bermico's unusually smooth bore prevents chafing or injury to wires or cables being pulled through . . . provides speedier fishing.

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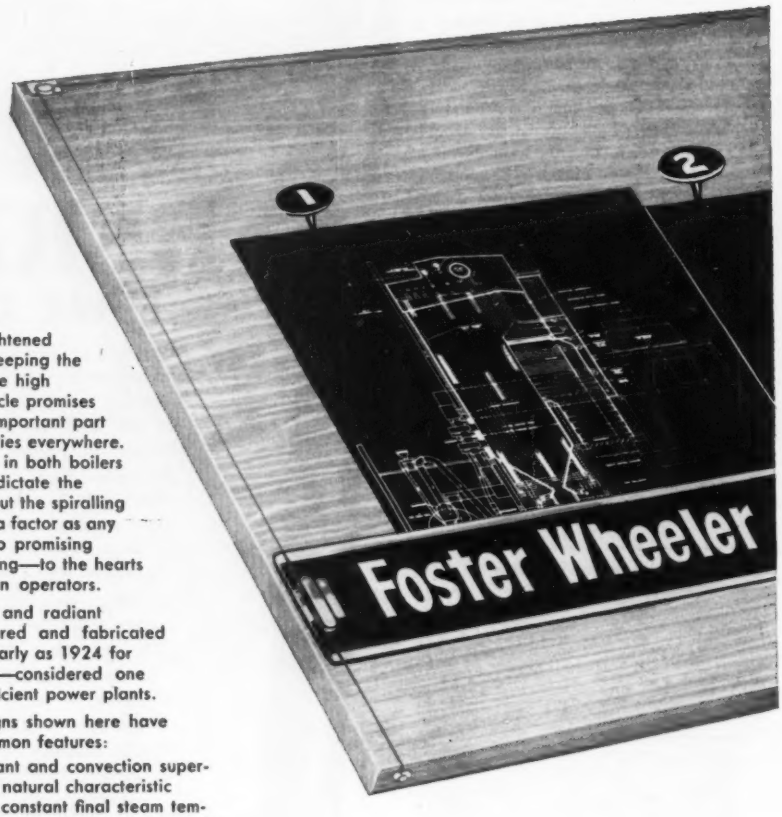


A new wave of enlightened interest in Reheat is sweeping the country as the role of the high pressure, high steam cycle promises to play an increasingly important part in power-generating facilities everywhere. Today, design developments in both boilers and turbines frequently dictate the use of the Reheat Cycle. But the spiralling cost of fuels is as much a factor as any in endearing this tool—so promising from its very beginning—to the hearts of steam-electric station operators.

Radiant superheaters and radiant reheaters were engineered and fabricated by Foster Wheeler as early as 1924 for one midwest station—considered one of the country's most efficient power plants.

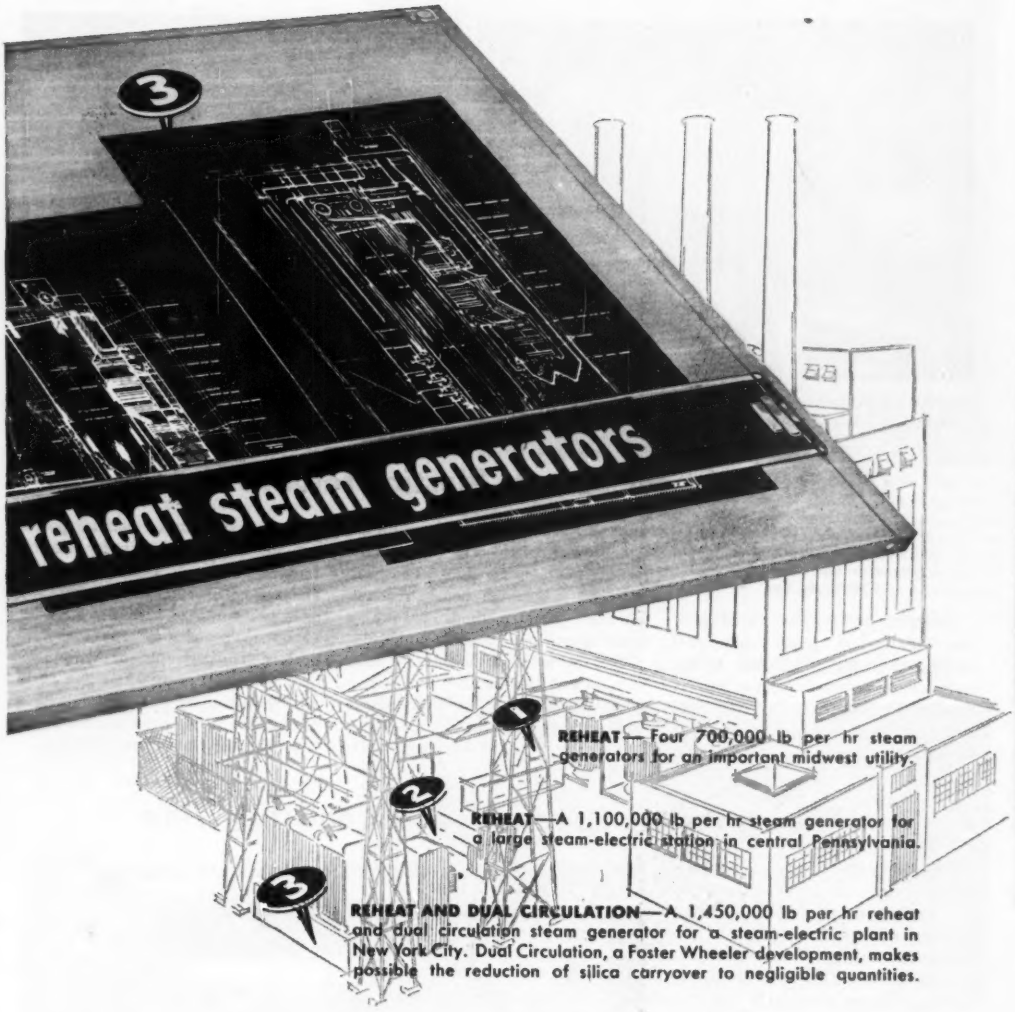
The Foster Wheeler designs shown here have the following common features:

(a) Combination radiant and convection superheaters have a natural characteristic maintaining a constant final steam temperature over a wide load range with a minimum amount of control equipment.

(b) Since superheating is done partly in the radiant superheater a two-fold purpose is served. Gas temperature leaving the furnace can be reduced and danger of slagging is thus obviated.

(c) Steam generator characteristics are integrated with those of the turbine.

For further information, write to: **FOSTER WHEELER**



REHEAT— Four 700,000 lb per hr steam generators for an important midwest utility.

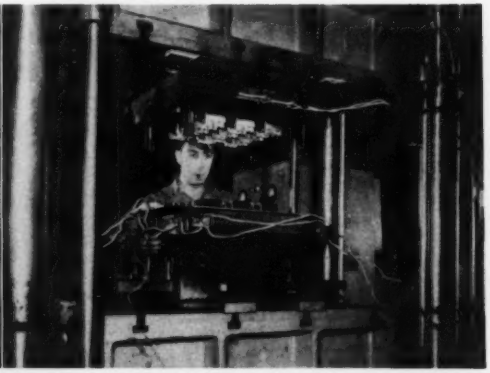
REHEAT—A 1,100,000 lb per hr steam generator for a large steam-electric station in central Pennsylvania.

REHEAT AND DUAL CIRCULATION—A 1,450,000 lb per hr reheat and dual circulation steam generator for a steam-electric plant in New York City. Dual Circulation, a Foster Wheeler development, makes possible the reduction of silica carryover to negligible quantities.

CORPORATION • 165 BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

PLASTIC PREFORMS are heated to 275F in 45 sec in this 5 kw, dielectric heater. Other methods require much more time



ELECTRIC STRIP HEATERS on the platens of this press provide the heating for forming plastic parts. Heaters total 9-kw

Dielectric Heater Speeds Plastic Preforms Heating

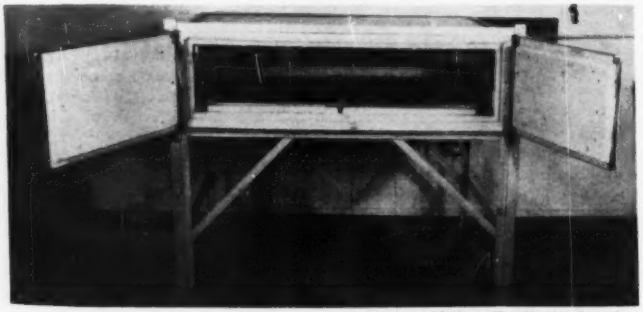
J. R. TAYLOR
Industrial Representative
Duquesne Light Company
Pittsburgh, Pa.

Dielectric heating has proved to be the fastest and most economical method of heating preforms in the manufacture of plastic parts at Squires Plastics, Inc, Verona, Pa. The preforms are heated uniformly throughout and the molding materials are free from surface "crust" or hard lumps which frequently occur when other heating methods are used. The heating cycle is accomplished in seconds, whereas other methods require a much longer time, possibly hours.

Two 5-kw dielectric heaters have been used at this plant for heating preforms for over 5 years and have proved to be very satisfactory. This firm makes a variety of plastic parts including coffee maker handles, potato cutters, terminal blocks for electric ranges, ink wells, mine fuse cases, and a host of other items. Phenolic resin preforms are heated to 275F in about 45 seconds in the dielectric heaters. The preforms are then placed in a hydraulic press where the parts are formed under heat and pressure. The platens of the press are heated to 350F by nine 1,000-w strip heaters.

Heating Panels Speed Plastic Preheating Time

Preheating time of plastic television masks is cut from 5 to 2 min by the use of special ovens with glass heating panels at the Haberland Mfg Co, Allwood, N. J. Maintenance and replacement of the heating equipment has been entirely eliminated and current consumption has been reduced over previously used method. Heat distribution is more uniform and there is no longer any difficulty with melted, uneven, or lumpy plastic. The two ovens were designed and developed by Ward Dennison, engineer at the Haberland Co. They have a connected load of 8kw.



Continental Radiant Glass Heating Corp photo

GLASS HEATING PANELS in special oven provide uniformly distributed heat for preheating plastic TV masks. Both time and energy consumption are reduced

INDUSTRIAL BRIEFS

Stamping Washers and Gaskets is speeded with infrared installation which more than paid for itself in a month in saving time and materials at Penn Fibre & Specialty Co, Philadelphia, Pa. The 10 250-w lamps, installed over rack which holds strips of fibre impregnated with plastic resins removes brittleness before strips enter stamping machine. This enables operator to punch out washers and gaskets at closer spacings and nearer to edges without fractures and rejects.

Controlled heat of lamps keeps strips uniform and unaffected by seasonal temperatures and humidity.—L. Albertson, application engineer, Philadelphia Electric Co.

Quality Control in manufacturing has been facilitated by an indicator which electrically counts the number of items produced and the number rejected, showing instantly on a meter whether the reject percentage is acceptable or too great. Supervisory personnel know right away when trouble is present and that immediate steps toward correction must be taken. Rejects in excess of a predetermined rate move the meter needle into a red section of the scale. Sagging quality is caught before unsatisfactory products, material, or parts can accumulate. General Electric Co.

Auto Paint Drying by a motor-driven infrared lamp-arched drying oven at the Jolly Motor Co, Savannah, Ga., cuts drying cost to 28 to 35 cents per car and saves 108 kw capacity for utility company supplying service. Customer also saves in reduced wiring and switchgear costs. Oven makes three passes over car in 30 min. Oven has 72—375-w infrared lamps (27 kw total) which is only about 20% of normal capacity of standard auto paint drying ovens. C. D. Anderson, power sales engineer, Savannah Electric and Power Co, Savannah, Ga.

Heat Treating textile machinery bearings with induction heat in the Saco-Lowell shops has increased production 145% with annual savings of $18,800. Direct labor costs have been cut 63% and a higher quality roll is produced. Westinghouse RF generator is 50 kw-450 kc.

Foundry Mold Room Lighting

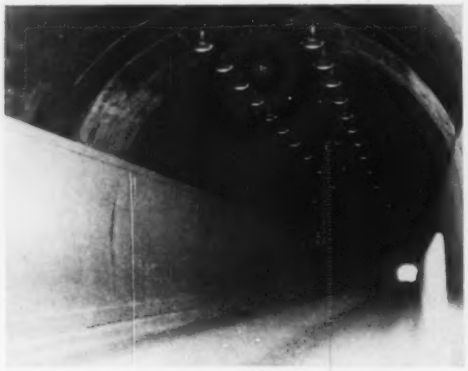
General Electric Co. Lamp Dept photo

REFLECTOR LAMPS (500-w R-52) in porcelain sockets are spaced on 16 ft by 16 ft centers with extra lamps at center of each square over important working areas. Mounting height is 16 ft. Illumination in major working areas is about 40 ft-c. This lamp has its own built in reflector which cannot become dirty. Dirt settles on upper part of lamp where it does not affect efficiency of system. Installation is at the Southern Shuttles Division of the Steel Hettle Co, Greenville, South Carolina

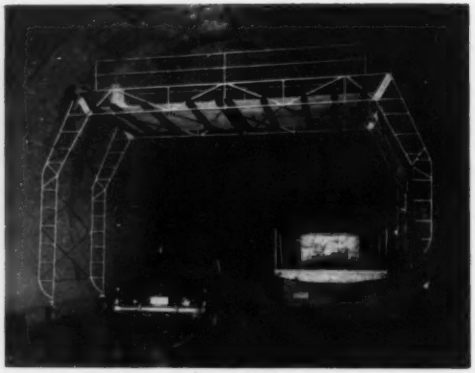
Dielectric Heat Cuts Bonding Time

Westinghouse Electric Corp photo

BONDING PLYWOOD with dielectric heat enables a clock manufacturer to cut to 90 sec the time required for bonding three pieces of plywood into a chime clock case. Previously-used animal glues, air-dried in the rotating rack shown in background, required a minimum setting time of 4 hr under ideal conditions. Radio-frequency generator applied to press has a rating of 2 kw at 13.6 megacycles



MERCURY VAPOR LIGHTS provide 50 ft-c of lighting at the tunnel entrances, tapering to an average of 4.3 ft-c in about 250 ft. Photoelectric control turns the lights on and off



ROLLING SCAFFOLD permits installation of the lights without interrupting traffic. It was test-loaded for 5,000 lb dead load, cost $1,500 to build, and will be used for maintenance

Mercury Vapor Lights Tunnels at Low Cost

In the face of a trend toward fluorescent lighting for tunnels and underpasses, the city engineering department at Seattle, Wash., has installed a mercury vapor lighting system in two vehicular tunnels with very good results.

Seattle has standardized on mercury vapor lights for its street lighting program, having installed more such lights than any other city, but the principal reason for such installation in the Lake Way tunnels was a matter of economy. It was found that the cost of a mercury vapor installation would be about two-thirds less than fluorescent lighting. Since each tunnel carries one direction of traffic and the peak of the tunnel dome is 23 ft above the roadway, it was possible to get a 20-ft mounting height and to shield the light from the drivers' eyes, thus taking advantage of this high-intensity light source without danger of glare.

Luminaires are mounted on 40-ft centers, staggered, providing an average intensity of 4.3 ft-c at the pavement level except at the tunnel entrances. This compares with an average intensity of 0.35 ft-c provided by the former sodium vapor lights mounted at 60-ft centers, and 1.2 ft-c provided by arterial street lighting.

Entrance Lights Taper Off

Tunnel entrances provide higher intensity lighting, beginning with 50 ft-c and tapering off gradually to the level of the light in the tunnel in about 250 ft. This permits the eye to become adjusted from the high intensity of the sunlight to the relative darkness of the tunnel. Photoelectric control turns these lights on in the morning when daylight reaches 500 ft-c and off at night when daylight falls below 400 ft-c.

Walls were painted at the tunnel entrances, as an additional aid to the transition lighting. Painting was not extended throughout the rest of the tunnel, as it would provide an unnecessary and costly maintenance problem.

Since all the work had to be carried on while the tunnels were in use, the city engineering department designed a special rolling scaffold to span the roadway and to fit the bore of the tunnel. The scaffold gives horizontal and vertical clearance for two lanes of traffic. It provides a working platform within easy reach of the new lights and also a place for painters' planks in painting the walls and ceiling. Made in demountable sections, the scaffold can be taken apart and stored conveniently for future maintenance work.

The lighting was designed under the direction of Ward Tyler, principal engineer in charge of design for the city engineering department, under City Engineer R. W. Finke.

Dairy Farm Uses 28 Kwhr Per Cow Per Year

Energy use of 7,827 kwhr was recorded in the year ended February 28 last by an 18-cow dairy farm on the lines of the Central Vermont Public Service Corp. E. C. Hathaway, director of commercial and power sales of the utility, instanced this as a reasonable figure to aim at, speaking at a recent meeting of the New England

...TO GIVE YOU A CONTROL CABLE THAT AVERAGES* 46% SMALLER IN AREA

By teaming Polyethylene with Nylon on conductors — sheathing the cable with Rockhide — Rockbestos has developed a radically new and better control cable. It has high dielectric strength *plus* all the advantages of smaller size. As a result, you can put a 12 conductor cable in a conduit now carrying 6 or 7, or use smaller size conduit to save conduit fitting and installation costs. — Save steel.

It will pay you to get the PNR story. Write or ask your nearest Rockbestos representative.

*Average determined by comparison with competitive control cable.

QUICK FACTS ON NEW ROCKBESTOS PNR CONTROL CABLE

46% smaller area*... 28% smaller diameter*. Use smaller conduit and fittings or put more conductors in present conduit.

Dielectric breakdown . . . over 40 times operating voltage.

Versatile . . . bury it in the ground! Hang it on a pole! Use it in a conduit!

Lighter and smaller. Easier to handle, store, ship, pull through conduit.

Stands weather . . . sunlight, chemicals, oil, gasoline, grease.

Flexible to —25°C (—13°F). No cracking!

Rated 600 volts . . . conductor operating temperature 75°C (168°F).

ROCKBESTOS PNR

. . . another different, better cable by

ROCKBESTOS PRODUCTS CORPORATION, NEW HAVEN 4, CONN.

the originators of A. V. C.®

New York Pittsburgh | Cleveland St. Louis | Detroit Los Angeles | Chicago Oakland, California

Rural Electrification Institute. After deducting an estimated 1800 kwhr for household use, the remaining energy represents about 28 kwhr per cow, about double the figure of 5 years ago. Included among the farmstead uses at this place, in addition to usual dairy applications, are a barn cleaner, barn ventilation, and infrared heating in various ways. Mr. Hathaway emphasized that these enlarged uses of electricity must be sold to the farmer by demonstration of their profitableness to him.

Goal is 6,000 Kwhr per Year

The utility is setting its sights for an average of 6,000 kwhr per year for the farms on its system. The average last year was 3,400 kwhr for a revenue of $110 at 3.25¢ per kwhr. The company has 3,379 miles of line serving 13,608 farm and other rural customers, including some industrials. Annual consumption for these farm and other customers is 9,300 kwhr and revenue is $324 per mile of line.

Promotion Uses Disney Characters

DISPLAY MATERIAL in which characters from Disney picture are featured has been prepared for large and small retailers to promote sale of lamp bulbs

Alice will describe the wonders of lamp bulbs to all her friends in Wonderland this Fall. The Lamp Department of General Electric Co has announced that it will employ the "Alice in Wonderland" theme, tying in with the Walt Disney movie of the same name, in its Fall lamp promotion, scheduled September 8 to October 20.

This sales promotion activity will replace the "bulb snatching" theme, which has been used in the recent past for a Fall campaign. It is timed to coincide with the early showing of the full-length animated color movie, which had its premier showing in New York in August.

Lamps of the household variety will be featured in the promotion. Emphasized will be specialty lamps, including those containing the "DR" phosphor to provide better diffusion of light, and the 50-GA bulbs for use in bare-bulb ceiling fixtures to provide less reflected glare.

Ad Sells Appliance Service

RATES are low, too. That's what is said by the fine print, unreadable in this reproduction. This advertisement is one of a continuing series in which Georgia Power tells customers of the many different services available to them

Sales and Service Notes

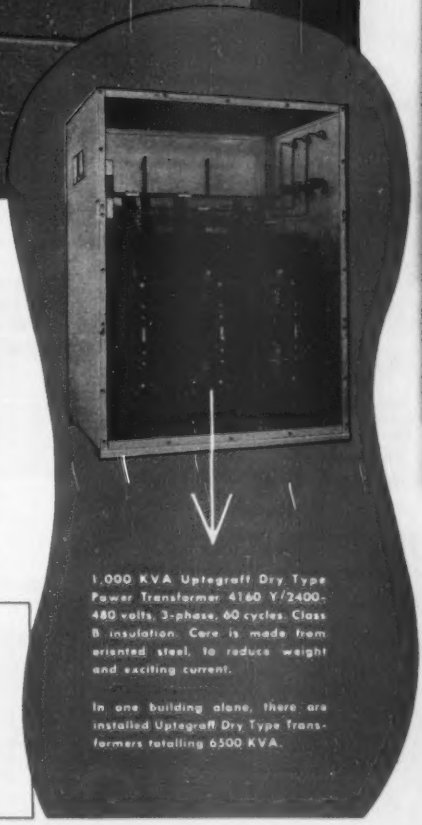
○ Frigidaire has recently announced three additions to its line; two refrigerators and a range. One of the new refrigerators (M-81P) is an 8.1 cu ft Master model with storage for 41 lb of frozen food and capacity to freeze 8 lb of ice. The other (SO-110) is an 11 cu ft Standard model with 29-lb frozen food capacity. The new range (RO-20) is designed for smaller budgets, but has many features of the more expensive 40-in. models, including slanted front and one-piece top with cooking lamp.

● Trend to larger refrigerator sizes is reflected in allowances now being made by builders in small mass-produced houses. Even in minimum low cost housing many kitchens are designed to accommodate 8 cu ft boxes, according to a survey by Hotpoint, Inc. A check of 148 existing homes made by distributor installation and service men in all parts of the country showed that 91% have space enough to accommodate refrigerator widths of all types of 8 ft models now on the market. Before the war 6 ft boxes were in largest demand, accounting for 78% of industry shipments. In 1950 this size represented about 10% of the shipments. Meanwhile, the 8 ft size which was 8% of industry shipments in 1940 has increased to about 40%.

With noise level well under N.E.M.A. standards, this Uptegraff Dry Type Power Transformer is ideal for hospitals, commercial buildings, institutions, central station auxiliary service and other installations where quiet operation, as well as economy, efficiency and dependability are desired. As shown in the photograph above, a noise-meter check is part of the regular factory-testing procedure to which these Uptegraff Transformers are submitted before shipment.

Other features are: electrical and mechanical ruggedness; light weight; high efficiency; safety and dependability. Class B insulation is used for these units.

The Uptegraff production system permits us to build and ship Power, Distribution and other types of transformers in all commercial sizes and ratings with minimum delay. Your inquiries are invited.



1,000 KVA Uptegraff Dry Type Power Transformer 4160 Y/2400-480 volts, 3-phase, 60 cycles. Class B insulation. Core is made from oriented steel, to reduce weight and exciting current.

In one building alone, there are installed Uptegraff Dry Type Transformers totalling 6500 KVA.

R. E. UPTEGRAFF
MANUFACTURING COMPANY
SCOTTDALE, PENNSYLVANIA
Makers of: POWER, DISTRIBUTION,
INSTRUMENT and SPECIALTY TRANSFORMERS

DESTINATION:
MECHANICAL
RECTIFIER
I-T-E
DESIGNED AND BUILT BY
I-T-E CIRCUIT BREAKER CO.
PHILADELPHIA, PA.
U. S. A.

MANILA

I-T-E Mechanical Rectifier to Provide D-C Power for Philippine Chlorine Production

Otto Jensen (right), manager of the Rectifier Division, I-T-E Circuit Breaker Company, Philadelphia, explains cathode ray oscilloscope reading of contact timing on new mechanical rectifier installation for the Superior Gas and Equipment Company, Manila, Philippine Islands. Observing the demonstration are (left to right) D. Tiosejo, Vice President of the Philippine company; H. G. Noordberg, Vice President; and B. D. Van Eyck, Industrial Equipment Manager, Philips Export Corporation of New York.

PHILADELPHIA: A step toward making the Philippines independent of outside chlorine supplies was taken recently when the first I-T-E Mechanical Rectifier manufactured for export was shipped to Manila from the Port of Philadelphia.

The rectifier will be put into operation this fall in a new $700,000 chlorine plant near Manila. The plant will produce an estimated six tons of chlorine daily for water chlorination, bleaching, and civil defense purposes.

Designed to produce an uninterrupted source of d-c power for plant operation, the rectifying equipment has a rating of 12,000 amperes at 65 volts.

The rectifier was purchased through Philips Export Corporation, New York City, by the Superior Gas and Equipment Company, Manila, whose Chief Engineer and Director, M. I. Felizardo, and Vice President, D. Tiosejo, supervised acceptance tests at the I-T-E Philadelphia plant.

Deciding factors in Superior's selection of rectifying equipment were the mechanical rectifier's high inherent efficiency (96.6%), the small space requirement, low maintenance cost, and ease of operation.

I-T-E Mechanical Rectifiers are available in units rated from 4,000 to 10,000 amperes, in any voltage from 50 to 400 volts d-c. Primary voltages, 2,300 to 22,000, three-phase a-c.

I-T-E Bulletin 5106 contains complete technical information on the Mechanical Rectifier, including a detailed presentation of operating principles. Send for it today. I-T-E Circuit Breaker Company, 19th and Hamilton Streets, Philadelphia 30, Pa.

The I-T-E Company

NEW EQUIPMENT

Hydraulic Dragshovel For Conduit Trenching

Easily converted in the field to clamshell or crane service, the Hydrohoe is reported useful in erecting substations, setting transformers, placing light poles and street lamps, laying conduit, and handling material of heavy and cumbersome construction on the job.

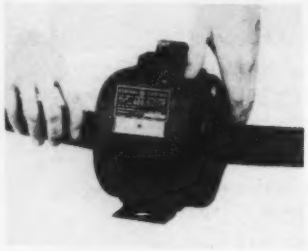
Every work function of the machine is fully hydraulic—boom hoist, swing, dipper dig and dump, boom telescope, outrigger set and retract, and positive dirt ejector.

Effective working depth over the rear of truck is 12½ feet. Maximum reach is 23 feet.

Hydraulic pumps operated through a power take-off from the regular truck engine furnish power.

The hydraulic ejector built into the dipper pushes the load out with a positive forcing action eliminating the jerking and jarring necessary to shed sticky material with a conventional bucket.

Bucyrus-Erie Co, S Milwaukee, Wis.



Current Transformers

Butyl-molding has been applied to a new line of 600 volt current transformers, announced by GE.

Butyl insulation is reported to combine low moisture absorption with good corona and sunlight resistance, excellent adhesion to copper very low power factor and excellent mechanical strength. Molded insulation permits compact designs meeting standard mounting dimensions for indoor applications, and is completely waterproof for outdoor service.

First of the line is Type JKP-O, a 600 volt window type with primary ratings of 200, 400 and 600 amperes. It is designed to carry 200 per cent of rated primary current continuously.

General Electric Co, Schenectady

Mine Power Center

High-voltage section of a new ventilated dry type mine power center consists of a cable disconnecting plug and receptacle, and a primary circuit breaker.

Low voltage section may have as many as four L frame breakers, which are accessible through hinged doors on the side of the unit.

Cable receptacles provide for connection to low-voltage feeders. Each breaker is equipped with ground fault protection.

Also available is a lighting tap or auxiliary lighting transformers, together with an "F" frame breaker to provide a 240 or 120 volt single-phase lighting supply.

Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.

•

Screen Heater

Originally developed to facilitate screening of moist clay, the Hannon Electric Screen Heater may be used to speed up screening of any non-conducting, non-explosive moisture containing material.

Applicable to No 2 woven wire screen or smaller, the unit provides a low voltage current which produces a resistance heat loss in the mesh.

Bus bars, connected to a step down transformer, extend the full length of the screen on each side.

F. R. Hannon & Sons, 1653 Waynesburgh Road, Canton, Ohio

•

10 Hp Motor Starter

Rated at 10 hp, 220-550 volts, 3-phase ac, a recently announced magnetic unit is neither a No 1 nor No 2 starter but an in between size suited for 10 hp motors.

The manufacturer reports a considerable saving over the No 2 unit (rate at 25 hp) reportedly used for 10 hp service.

Furnas Electric Co, Batavia, Ill.

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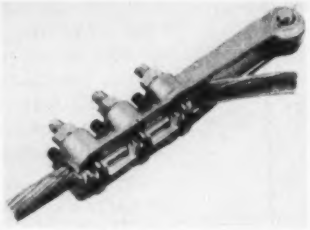
Improved Strain Clamp

The Type DUW all-bronze strain clamp for dead-ending copper cable has been redesigned to streamline and redistribute metal for greater strength and greater holding power.



The complete DUW line, made in six different sizes, accommodates cable ranges from No 1 stranded to 2000 Mcm and is recommended for use on both hard and soft drawn cable.

Burndy Engineering Co, New York, N. Y.

•

High Intensity Spotlight

A new 300 watt outdoor unit designed to concentrate its light in a long-throw, oval shaped beam provides 100,000 candle power.

This unit, the No 56 spotlight, is recommended by the manufacturer

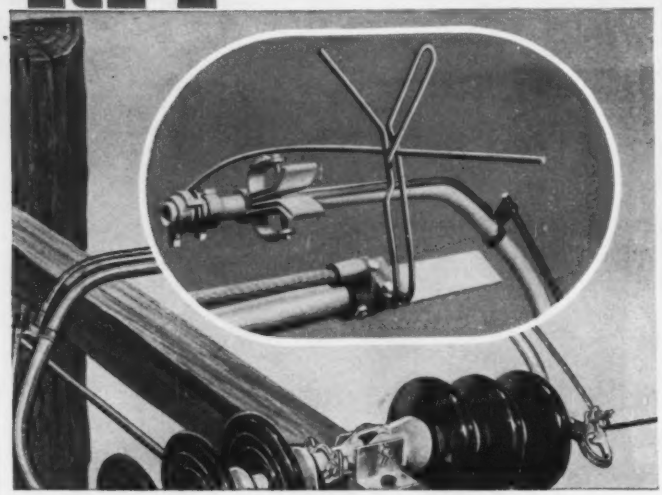
whether it's straight line or corner construction . . .
***it calls for* HUBBARD INSULATOR PINS**

Hubbard Wide Base Clamp Pins, Nos. 24320 and 4320 for angle or corner construction, are forged from new hot-rolled open-hearth steel. The broad bases of these pins present a large area to the arm, reducing "burning" and cutting into the wood to a minimum. The four lugs prevent the pin from turning on the arm. They are available in Carriage Bolt and U-Strap types as illustrated. Carriage Bolts and Plate are included with the No. 24320 style.

Hubbard Angle Type Cross Arm Corner Pins, No. 4309 style, are made from certified malleable iron for use on 4 by 5-inch cross arms. The back of the pin (the portion farthest from the bolt) is placed to the inside of the angle of the line, providing a leverage which offers maximum resistance to corner loading. They come with 1 and 1⅜-inch lead threads and for 1⅜-inch thimbles. Mounting Bolt, ⅝ by 6-inch, with washer, nut and lock nut is included.

HUBBARD AND COMPANY
ESTABLISHED 1843
PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA
"Hang the Load on Hubbard Hardware!"

KPF **POLE TOP SWITCHES**



Drop 40 miles of 69 kv lines with KPF Quick-Break pole top switch

Operating engineers tell us KPF switches with Quick-Break attachment are the most outstanding air-break switch improvement in 25 years. Before development of this Quick-Break device, pole top switching of 69 kv circuits was limited to some 6 miles of line. Now, operating experience shows that 40 miles of 69 kv line can safely be dropped with this equipment.

The secret of the KPF Quick-Break is a heavy-duty cat's whisker which whips free in a split second as the switch is opened. This mechanism prevents establishment of an arc; thus critical arc length is no problem.

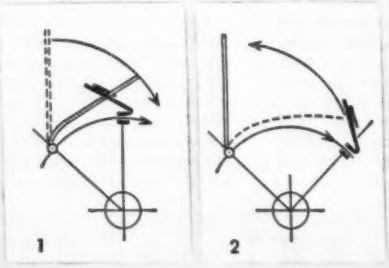
The KPF Quick-Break attachment is simply and ruggedly constructed for low cost, long life and all-weather dependability. It is available for all KPF switches rated 15 to 69 kv.

HERE'S HOW KPF QUICK-BREAK WORKS

1. Spring rod winds to full tension as switch opens.

2. Rod springs clear, breaking contact at high speed.

Write for details of KPF Quick-Break attachment and low cost, long-lasting, easy-to-install KPF Switches.



KPF **ELECTRIC COMPANY**
1624 E. Alpine Avenue · Stockton, California

for area protection lighting.

Made of non-corrosive, heavy duty cast aluminum and threaded ½ inch NPT, units have wiring completely enclosed.

Up to five units may be mounted in a single cluster.

Stonco Electric Products Co, 489 Henry St, Elizabeth 4, N. J.

•

Snow Remover

Powered by a ½ hp capacitor motor the Snow-Blow tosses snow to either side.

One hundred feet of No. 14 plastic extension cord are provided. A grounding drag chain reportedly eliminates electrical shocks.

Sensation Mower Inc, Ralston, Nebr.

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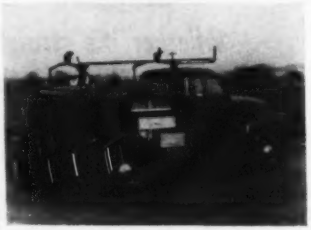
Truck Body

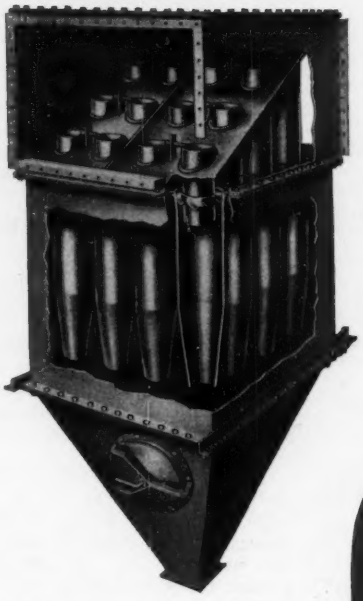
Model 201V76 light duty service installation body is designed for mounting on the conventional half-ton commercial chassis with cab.



Overhead ladder brackets can be furnished in five types for: One extension ladder; one extension ladder and crossarm bracket; one extension ladder and tool rack; two extension ladders; one extension and one single ladder.

A variety of optional equipment is available at extra cost.

York-Hoover Corp, York, Pa.



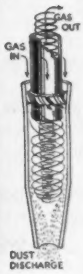
No wonder "MULTICLONE" *is the leading name in the centrifugal recovery of dust and fly ash from all types of gases, hot or cold.*

No other mechanical recovery equipment has so many years of dust and fly ash recovery experience behind it . . . or has such uniformly high collecting efficiency . . . or provides so many other money-saving, space-saving advantages as MULTICLONE. The four advantages outlined below are by no means the complete MULTICLONE story, but are typical of the vital savings found *exclusively* in MULTICLONE equipment . . .

In dust and fly ash recovery

MULTICLONE COLLECTORS

***and only Multiclones* give vital advantages like these . . .**



Uniformly High Recovery:

MULTICLONE's multiple *small diameter* tubes—made possible by its exclusive vane design—whirl the dirty gases with greater centrifugal force, thus throwing out not only the large, medium and small particles, but also a high percentage of the *extremely small* particles of 10 microns and less. This, coupled with the fact that there are no pads or filters to become choked with recovered material, results in a more complete recovery of *all* suspended materials from the gas stream.

Space-Saving Compactness:

Plant space costs money—so be sure to check space requirements carefully. As shown in the accompanying chart, the MULTICLONE requires less floor space and less cubic space than any other unit of comparable capacity and performance. Translate these savings into today's high costs for plant space and you readily see the great importance of this one MULTICLONE advantage alone!

Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

Long and narrow

Square

Maximum Adaptability:

In addition to its unusual compactness, the MULTICLONE is also unusually adaptable to various installation requirements. Where head room is low it can be installed with side-inlet side-outlet connections. Where side clearances are restricted, it can be installed with side-inlet top-outlet connections. In addition, without changing capacities, the shape of the unit can be varied—long and narrow, short and wide, or square—to fit restricted spaces . . . and its single-inlet single-outlet duct requirements permit greater flexibility and simpler installation. These savings slice installation costs, space requirements and insulating expense.

Minimum Maintenance:

The MULTICLONE has no high speed moving parts to repair or replace . . . no pads or filters to clean or renew . . . nothing to choke the gas flow or increase draft losses as suspended materials are recovered. MULTICLONE draft losses remain uniformly low *at all times*. Further, the recovered material from an entire bank of tubes is collected in a *single* hopper—far easier to service and maintain than the multiple hoppers of conventional cyclone units.

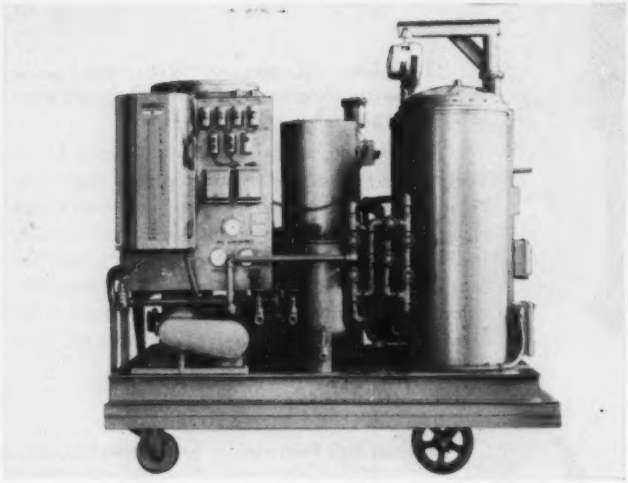
FREE INFORMATIVE BOOKLET
This 32 page booklet outlines the basic principles of centrifugal dust recovery and shows the *many* ways MULTICLONE advantages assure higher recovery at lower overall costs. A free copy of this booklet will gladly be sent on request. Write today!

Before you decide on any recovery equipment be sure to get complete information on MULTICLONE advantages. A letter, wire or phone call to our nearest office places this information in your hands without obligation. Get *all* the facts and you will get MULTICLONE Collectors!

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1004 WEST NINTH STREET, LOS ANGELES 13, CALIFORNIA
CHRYSLER BLDG., NEW YORK 17 • 1 LaSALLE ST. BLDG., 1 N. La SALLE ST., CHICAGO 2 • HOBART BUILDING, SAN FRANCISCO 4, CALIFORNIA
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL



Oil Purifier

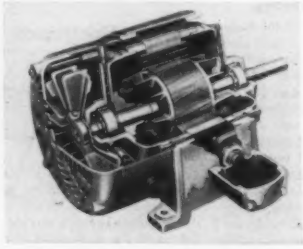
Acidity, moisture, and sludge may be removed from transformer and circuit breaker insulating oils with the new mobile Houdaille Purivac.

This unit restores interfacial tension and dielectric strength of oil in one operation.

The assembly consists of a heat exchanger, dehydrating and degasifying unit, electrical control panel; pumps and motors.

Dual purification units may be operated separately, in parallel, or in series. If used in the field the unit can be connected directly to the transformer and operated while the transformer is in or out of service.

Honan-Crane Corp, 734 Wabash Ave, Lebanon, Ind.



Explosion-Proof Motor

Manufactured in capacities ranging from 3 to 75 horsepower, this new motor, Types SE and SES, carries the Underwriters' label in Class I, group D, for highly inflammable gases and volatile liquids and in Class II, groups F and G, for combustible ducts.

Other types, SD and SS, without label are available for non-explosion-proof service.

Features include: Sealed terminal, elongated spark-arresting bearing sleeves, removable cover.

U. S. Electrical Motors Inc, 200 East Slauson Ave, Los Angeles 54, Calif.

Magnetic Starter

A new ac combination magnetic starter equipped with a three-pole fused or unfused manual disconnect switch has been developed for use with squirrel-cage motors for full voltage non-reversing starting or for use with wound rotor induction motors as primary switches.

When used with start stop controls this unit provides low voltage and overload protection. Fused disconnects provide short-circuit protection to wiring. The thermal overload relays in the magnetic starter element provide inverse time limit overload protection and are designed to follow the motor heating curve within close limits.

The Euclid Electric & Mfg Co, Madison, Ohio

•

Welder Control

A new arc drive control to produce electrical transient characteristics desirable for certain welding operations is now available on Type RA selenium rectifier welders, manufactured by Westinghouse.

This device operates automatically and instantaneously to provide a surge of welding current at the moment the arc becomes shorted. This surge helps clear arc path and prevents outage or electrode sticking.

The amount of arc drive can be set by the operator. Adjustment is not critical. A self-heating thermostat is provided to protect the circuit from damage due to sustained short circuit of the welding electrode.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

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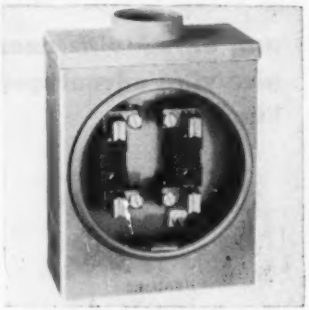


Socket Meter Trough

This new meter socket for domestic watt hour meters is available in single or multiple units, arranged either vertically or horizontally.

Two sizes are available—3/0 and No. 1 wire size. Cover is secured by a sturdy cadmium plated latch concealed by the meter.

Milbank Manufacturing Co, 413 West 10 St, Kansas City, Mo.

MORE NEW EQUIPMENT

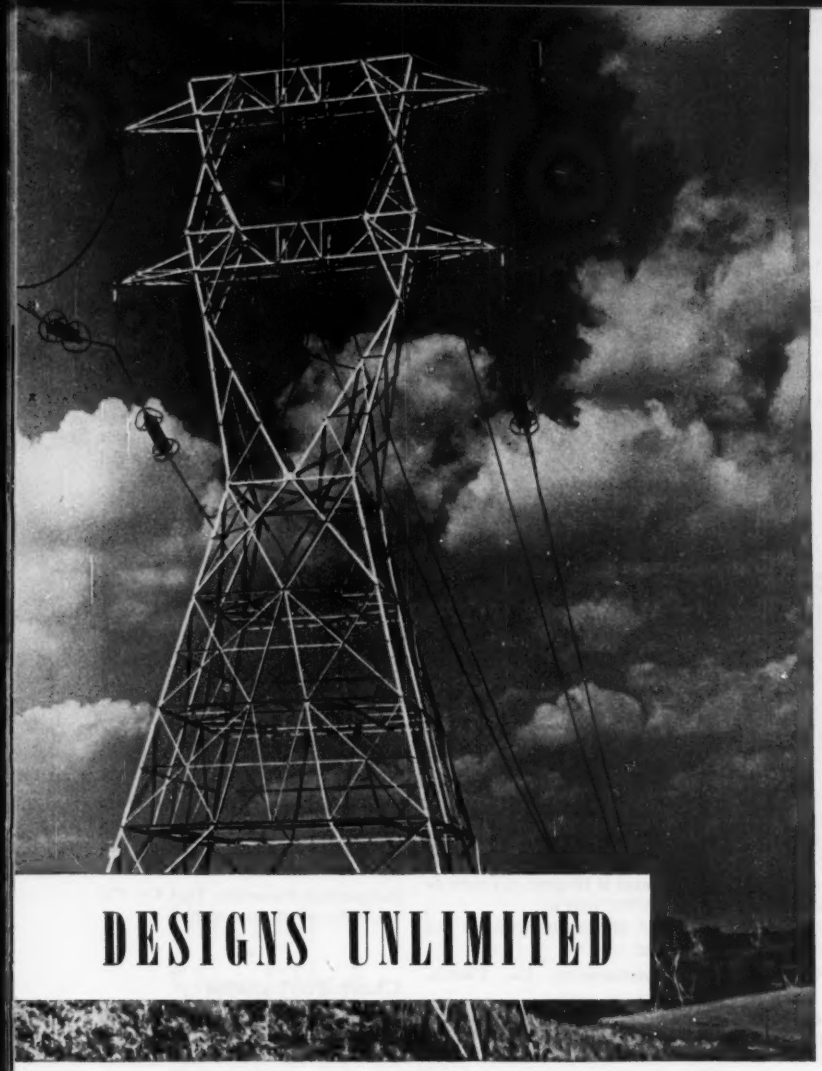
Just Received

Appearing Next Issue

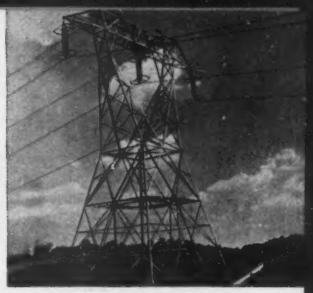
Fluorescent Mercury Lamp
New light source provides whiter light from mercury-vapor

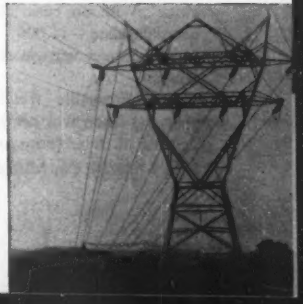
High Cycle Hand Tool MG Set
MG set converts 60 to 180 or 360 cycles for electric hand tools

Demineralizer
Raw water passing through column only once has mineral content reported virtually zero



DESIGNS UNLIMITED





If your engineers have their own ideas on tower design, well and good. We will follow them to the letter and adhere closely to specifications. Your engineers realize, as we do, that despite general similarity no two towers are alike. Each tower must be designed for its particular location and purpose.

Let us apply our four decades of experience in building towers for any and all conditions of terrain and load, to your power transmission problems.

BLAW-KNOX DIVISION OF BLAW-KNOX COMPANY
2013 Farmers Bank Building, Pittsburgh 22, Pa.

BLAW-KNOX
TRANSMISSION TOWERS

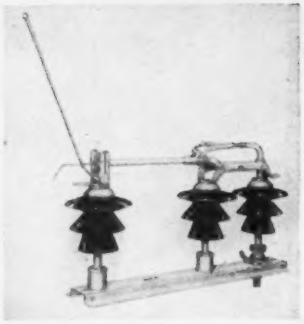
Horn Gap Switch

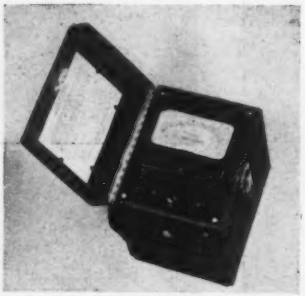
The wide open gap feature of the previous R & IE type TTL has remained an important feature of the new TTL-49.

Service and operating advantages of the TTR-49 Disconnect Switch have been incorporated.

Features include sealed high-pressure hinge contacts, high thermal capacity contacts, weather-sealed greaseless bearings, and four bolt terminals.

Railway and Industrial Engineering Co, Greeensburg, Pa.





Insulator Tester

A new insulation resistance tester with a testing range from 0–100 megohms at 500 volts dc has been announced. This instrument also has a low range 0–10,000 ohms scale for circuit continuity testing.

The Vibrotest Model 264 is completely self contained with standard battery power source.

Associated Research Inc, 3760 West Belmont Ave, Chicago 18, Ill.

•

Protective Lighting

Two luminaires, the Spherolite and Fresnelite, have been added to the line of protective lighting equipment manufactured by Line Material.

The Spherolite provides IES light patterns, Type I through Type V and is designed for use with incandescent lamps up to 525 watts on multiple circuits or 10,000 lumens on series circuits. With no basic changes it will accommodate 11,000, 15,000, or 20,000 lumen vertical mercury vapor lamps.

The Fresnelite which projects a wide flat beam was designed for glare lighting of outer fence areas.

Line Material Co, Milwaukee 1, Wis.

Capacitor Motors

The Tri-Clad line of single phase capacitor motors has been extended to include a totally enclosed fan-cooled construction.

Starting capacitors and switch are mounted within the frame.

Ratings of 1, 1½, 2, 3, and 5 hp are available.

General Electric Co, Schenectady.

•

Snap-Action Switch

Design of the model TB-5000 switch incorporates an alnico magnet to blow out the arc.

Single pole double throw, this switch is rated at 10 amp, 125 volts dc and 5 amp 230 volts dc.

Pin, leaf, or plunger actuators can be obtained.

Acro Manufacturing Co, Canton, Mass.

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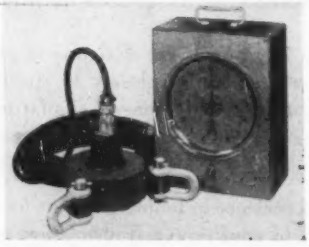


Remote Tension Indicator

Tractive load, tension, or weight may be measured remotely with the Tens-O-Trol.

Electro-mechanical in design, this unit is equipped with selsyn motor operated from a 12 volt external battery. Two repeater stations may be used with each tension transmitter.

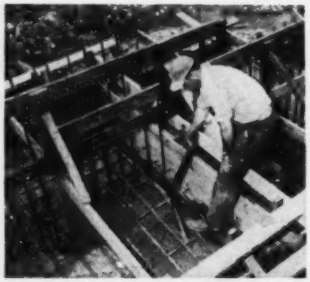
The manufacturer guarantees accuracy to 2% plus or minus of full scale reading. Twelve capacities ranging from 0-500 lbs to 0-50,000 lbs are available.

W. C. Dillon & Co, 1421 South Circle Ave, Forest Park, Ill.

•

Concrete Vibrator

Designed to compact freshly poured concrete and to direct its movement as it is poured into the forms, the 521 vibrator consists of a rotary air motor and vibrator unit sealed in a steel cylinder.



Adjustable automatic air line oiler and a roll type throttle providing up to 8,000 vibrations per minute are features of this unit.

Independent Pneumatic Tool Co, 175 North State St, Aurora, Ill.

•

Chart Photometer

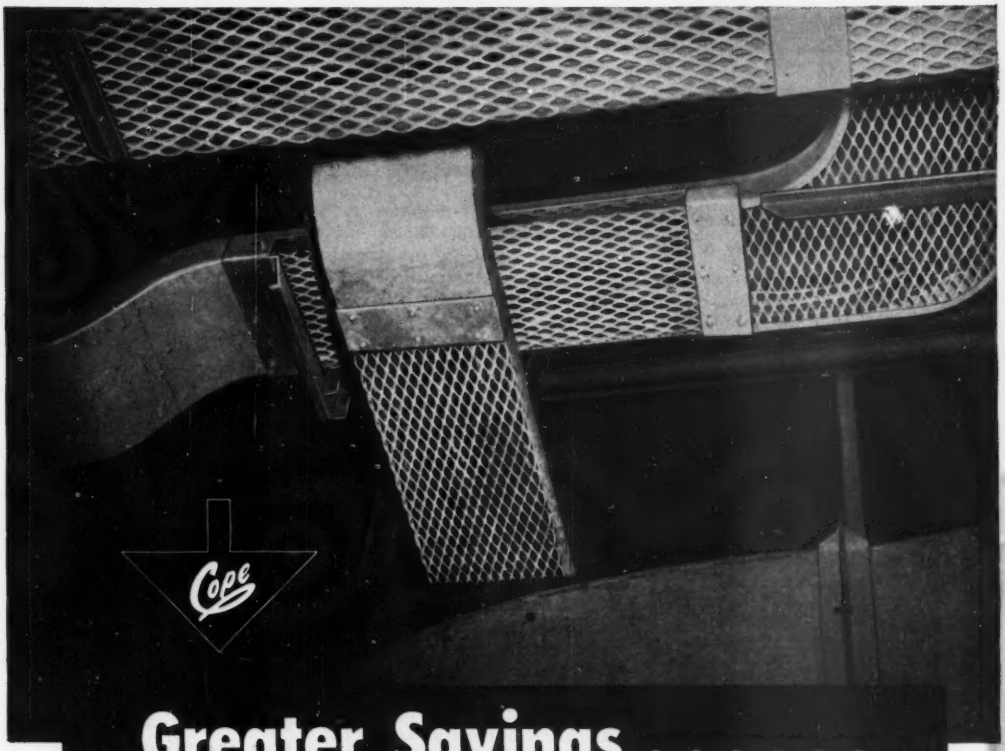
Reflectance may be measured quickly and accurately for three standard illuminants with a new compact set of color scales.

The reflectances of these scales were obtained from measurements made at the National Bureau of Standards on a series of standard color papers.

Developed especially for illumination engineers this chart will be found applicable to any color problem involving:

1. Reflectance measurement.
2. Checking on reproduction or transmission through a complete color gamut as in photography and television.
3. Reasonably accurate color notation for record and duplication.

Munsell Color Co, 10 East Franklin St, Baltimore 2, Md.



Greater Savings . . . . . .

through Simplified Design in Cope Cable Trough Installation

To save material is of the greatest importance to our Defense Effort. We daily read of cuts in allotment of materials for "non-essentials." And when essential equipment—such as Cope Cable Trough—saves material, not only our government but naturally all industry is interested. That's why so much Cope Cable Trough is being used by outstanding Utilities, Industrial plants and Government agencies.

By using standard Cope Cable Trough and Fittings—turns, branches, reductions, vertical as well as horizontal runs that can be so easily assembled—waste of materials during installation in the field are eliminated. For the same reasons, countless man-hours are saved in installation time.

If unusual problems of installation arise, the Cope Engineering Staff is at the service of customers to help design special fittings.

Since it is the duty of everyone to conserve—and since Cope Cable Trough saves material, labor and costs—you will want a copy of our latest Bulletin describing Cope Cable Trough. Won't you write for it today?

Cope

You know Cope by these Products . . .

T. J. COPE, INC., 711 SOUTH 50th ST., PHILADELPHIA 43, PENNSYLVANIA

NEWS ABOUT PEOPLE

California Utility Makes W. C. McWhinney a VP

W. C. McWhinney, assistant vice president of Southern California Edison Co, has been appointed a vice president of the company.

McWhinney started with Pacific

W. C. McWHINNEY

Light & Power Co in 1909 and joined Southern California Edison in 1917 when the two companies merged. Since that time he has served as general business agent, assistant general commercial manager, commercial manager, and became assistant vice president in the public relations department in 1936.

•

R. Allen Benjamin has been elected vice president and secretary of the Benjamin Electric Manufacturing Co, Des Plaines, Ill. The company also named **Arthur E. Swedenborg** assistant general sales manager. He had been central division manager and has been succeeded in that position by **Ivar H. Stockel.**

Ervin George Bailey, vice president of Babcock & Wilcox Co, has been selected to receive the 1952 John Fritz Medal and Certificate "for outstanding engineering achievements in the field of combustion and distinguished service to his fellows in advancing the engineering profession." The award is sponsored by the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.

W. W. Pickrell has been elected president and board member of the Salt River Project Agricultural Improvement & Power District. He succeeds Richard D. Searles, now U. S. Undersecretary of Interior.

•

Organizational Changes Made by Florida P&L

Florida Power & Light Co has announced organizational changes to streamline its operations and provide greater efficiency.

George C. Kinsman has been named vice-president in charge of operations to coordinate all electrical aspects of operations, including power supply, transmission, and distribution. R. A. Goodburn has been made chief electrical operator and will serve as principal assistant to Kinsman.

Managers of power supply, managers of seven divisions not including the Miami area, the Eastern division superintendent, the Miami area electrical superintendent, the chief engineer, the purchasing agent, the superintendent of gas, and the director of industrial relations and safety will report to Kinsman.

H. G. Williams has been reappointed to his former position of director of industrial relations and safety.

J. B. Hiers, vice president, is appointed director of economic planning and research. He will work in cooperation with other vice presidents and department heads, and handle special assignments for Robert H. Fite, general manager.

•

E. I. Ehret has been appointed chief engineer of the Joleco Corp, St. Louis. **Fred J. Buchal** has been named sales manager of the company.

Potomac Edison Appoints Startzman Chief Engineer

Potomac Edison Co, Hagerstown, Md., has appointed H. H. Startzman assistant vice president and chief engineer. He formerly was assistant chief engineer.

The utility also named Eugene

H. H. STARTZMAN

Gordon superintendent of power stations, and Cecil McVay assistant superintendent. George T. Sanders has been made general merchandise manager of the company.

Startzman joined the company in 1928 in Cumberland as manager of the merchandise department. The following year he was transferred to the industrial engineering department in Hagerstown and four years later was appointed manager of the power sales and engineering department. Startzman became assistant chief engineer in 1948.

Starting with Potomac Edison in 1923 as assistant chief engineer at the R. Paul Smith Plant in Williamsport, Gordon later became chief engineer and then superintendent of the plant. He also has served the company as superintendent of power.

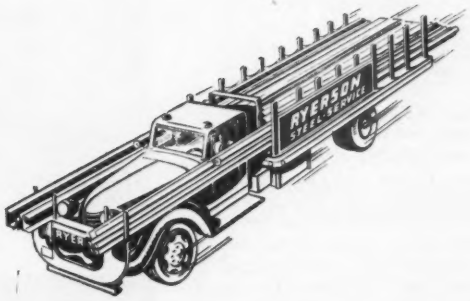
McVay has been with the company since 1937 except for four years spent in the armed forces during World War II. He began as a relief substation operator and has also served as junior engineer, load dispatcher, assistant plant superintendent, and plant superintendent at the Smith Station.

RYERSON

Ryerson Steel Service awaits your call at thirteen great plants, strategically placed across the nation.

STEEL

Every kind of steel is on hand for quick delivery. Though stocks are currently unbalanced, most requirements are usually available.



SERVICE

Ryerson representatives are ready to assist you on any problem involving the purchase, fabrication or application of steel.

PRINCIPAL PRODUCTS

CARBON STEEL BARS—Hot rolled and cold finished
STRUCTURALS—Channels, angles, beams, etc.
PLATES—Many types including Inland 4-Way Safety Plate
SHEETS—Hot and cold rolled, many types and coatings
TUBING—Seamless and welded, mechanical and boiler tubes
ALLOYS—Hot rolled, cold finished, heat treated. Also tool steel
STAINLESS—Allegheny bars, plates, sheets, tubes, etc.
BABBITT—Five types, also Ryertex plastic bearings
MACHINERY & TOOLS—For metal fabrication

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • CINCINNATI • CLEVELAND
DETROIT • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO

Sanders, formerly sales supervisor for Winchester, Va., and the southern district, joined Potomac Edison's sales staff in 1934. In his new position he succeeds L. S. Kight who has resigned because of ill health.

•

McNairy Made Manager of GE Appliance Project

J. W. McNairy has been appointed manager of General Electric Co's Appliance Park project at Louisville, Ky.

The former manager of engineering and manufacturing of the company's Major Appliance Department will be responsible for the building planning and construction program at the park.

In other recent appointments, GE named William E. Saupe operation manager and Will Pruessman manager of manufacturing of the Schenectady Steam Turbine and Generator Divisions.

McNairy, with GE since 1917, has served as a member of the control division of the railway department, assistant design engineer of the control division, assistant to the works manager at Bridgeport, and assistant Bridgeport Works manager. He became manager of manufacturing and planning of the former Appliance and Merchandise Department in 1945 and manager of engineering and manufacturing three years later.

Beginning with GE as a student engineer in 1917, Saupe was made head of the test course the following year and in 1922 assistant general foreman of Test. He later served as assistant superintendent of the Motor and Generator Department, superintendent of the Induction Motor Section, and superintendent of the Syracuse Turbine Plant. In 1946 he was named superintendent of the Schenectady Turbine Manufacturing Department and in 1947 manager of the Schenectady Turbine Manufacturing Division.

Pruessman joined GE in 1925 as a test engineer and worked in the Refrigerator Engineering Section and the Refrigerator Manufacturing Section. From 1930 to 1937 he was assigned to the Turbine Engineering Section in Schenectady and then became supervisor of the Wage Rate & Planning Section of the Turbine Manufacturing Division. In 1941 Pruessman was appointed assistant superintendent of the Turbine Manufacturing Division and seven years later superintendent.

Rost, Matthews Elected VPs of Appleton Electric

O. Fred Rost and Lorenzo J. Matthews have been elected vice presidents of Appleton Electric Co, Chicago.

Rost will have charge of industry relations. He formerly was editor of

O. F. ROST

L. J. MATTHEWS

"Electrical Wholesaling," a McGraw-Hill publication.

Matthews joined Appleton Electric in 1946 as chief industrial engineer. He previously held engineering posts with Aluminum Co of America and Montgomery Ward & Co. In his new position he will have charge of production.

•

William Sharpe has resigned as director of public relations for Carolina Power & Light Co to enter the magazine field.

W. L. Winter, application engineer for Westinghouse Electric Corp since 1916, has been made assistant to the manager of the company's Central Station Department, Pacific Coast District. In his new position Winter will coordinate promotion and sale of distribution apparatus to electric utility organizations in the district.

E. A. Murray has been named manager of the Compressor Division of Worthington Pump & Machinery Corp. He succeeds **Herman H. Miller,** who will act as consultant to Murray. Miller, with the company for 50 years, plans to retire at the end of the year. Assistant manager of the compressor division since 1948, Murray also served as electrical consulting engineer for the division. He joined the company in 1935 and previously worked for General Electric Co.

David C. Prince, General Electric Co vice president on the president's staff and former head of the General Engineering and Consulting Laboratory, has retired after 32 years' service. He joined the company in 1913 and became a vice president in 1941 in charge of application engineering for the Apparatus Department. He was named head of the General Engineering and Consulting Laboratory in 1945. Prince plans to enter the consulting engineering field.

OBITUARY

H. E. Reddick, field sales engineer in New York for the illuminating division of The Miller Co, Meriden, Conn., died Aug. 2. He had been with the company since 1916.

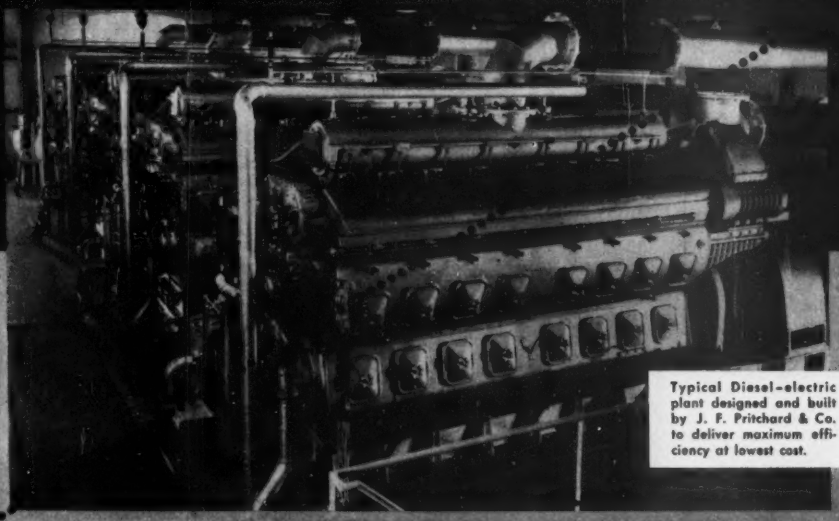
Cyrus W. Miller, 55, executive secretary of the Refrigeration Industry Safety Advisory Committee died at North Tarrytown, N. Y., Aug. 14.

C. Theodore Caesar, 62, credit supervisor since 1935 of Puget Sound Power & Light Co's southern district at Olympia, Wash., died recently.

John Farrell, 59, superintendent of McManus plant now being constructed by Georgia Power Co, died Aug. 2 at Brunswick, Ga.

Hermon R. Dyke, 49, general manager of Middleboro (Mass.) Gas & Electric Department since 1948, died at Middleboro Aug. 13.

Need Extra Power Generating Capacity?



Typical Diesel-electric plant designed and built by J. F. Pritchard & Co. to deliver maximum efficiency at lowest cost.

Develop It Quickly, Easily, Profitably With a Pritchard Diesel-Electric Plant!

Pritchard's Single Responsibility Contract Includes

Design
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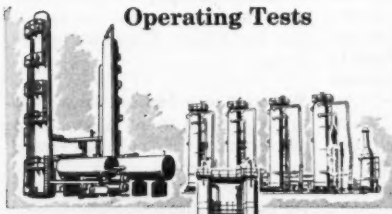
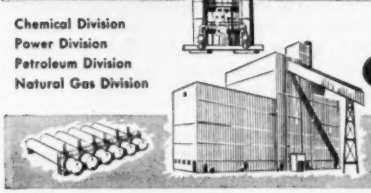
Operating Tests



Chemical Division
Power Division
Petroleum Division
Natural Gas Division



If you are a forward-looking industrialist or utility executive seeking to retain essential profit margins in the face of rising labor and materials expense, you'll undoubtedly recognize an adequate source of power as essential for improving plant efficiency and maintaining a profitable level of operation.

For more than a quarter-century, J. F. Pritchard & Company has rendered valued service to utility and industrial clients in this country and abroad concerning every variety of problem related to electric power generation.

You, too, are invited to rely upon the experienced engineering counsel of Pritchard's Power Division to make your next power installation *outstanding* in proved design, operating practice, equipment and construction. Write for complete information.

NATIONAL OIL WELL CONTRACTORS ASSOCIATION — MEMBER

J.F. Pritchard & Co.

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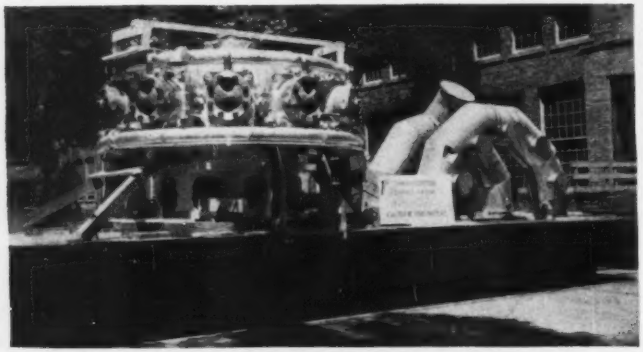
MANUFACTURERS and MARKETS



READY FOR SHIPMENT by flatcar to Kaiser Aluminum & Chemical Corp's new aluminum reduction plant at Chalmette, La., is 1,820-hp gas burning radial engine, built by Nordberg Manufacturing Co, Milwaukee. The engine is of the two-cycle type and has 11 cylinders of 14 in. bore and 16 in. stroke. It develops its rated horsepower at 400 rpm and is capable of driving 1,290-kw, dc generators

Production of Aluminum in Half Highest Since '44

Production of primary aluminum in the United States in the first six months of this year topped output in the corresponding period last year by 18% and was at the highest level since the first half of 1944, according to the Aluminum Association (EW, Aug. 20, p 3). The total for the first half was 807,181,724 lb.

June production totaled 134,906,971 lb bringing second quarter production to 405,750,262 lb.

Shipments of aluminum sheet and plate by member companies of the association's sheet division during June amounted to 87,501,761 lb compared with 90,855,584 lb during May. First half shipments, however, totaled 579,092,988 lb, an increase of 9% over shipments during the first half of 1950. Shipments were 272,320,993 lb during the second quarter of the year.

Foil shipments by members of the association's foil division in June amounted to 7,430,852 lb. The totals for the first half and second quarter respectively were 52,753,638 lb and 25,051,383 lb.

Shipments of permanent-mold rough castings, except pistons, by foundry division members totaled 19,232,462 lb during the first six months of the year and were valued at $11,128,220. June shipments were 2,363,609 lb., valued at $1,392,205; and second quarter shipments totaled 8,976,403 lb and had a valuation of $5,289,127.

•

Alcoa Subsidiary Plans to Raise Alumina Capacity

Aluminum Ore Co, a subsidiary of Aluminum Co of America, plans to increase the nation's alumina producing capacity by 180,000 tons a year. The company will add new production facilities at an existing plant in Mobile, Ala. Production is expected to begin in late 1952.

Alumina (aluminum oxide) is obtained from bauxite ore as the major preliminary step in the production of aluminum and alumina chemical products.

The company also is constructing new alumina works at Bauxite, Ark., and operates a plant at East St. Louis, Mo. The expansion programs at Mobile and Bauxite will increase Aluminum Ore's alumina production capacity by about 70% when completed.

MANUFACTURING BRIEFS

The world's largest single flywheel motor generator set, with a 65-ton flywheel and a 9,000-hp motor, will be built by Westinghouse Electric Corp for installation in Great Lakes Steel Corp's new slabbing mill being constructed in Detroit. The motor-generator set will have a capacity of 250,000 hp-second stored energy.

General Electric Co has restored to service more than 1,000 pieces of flooded electric apparatus at its service shop facilities in Kansas City since the peak of the floods in that region. The rehabilitated equipment includes motors, transformers, circuit breakers, control devices, and other items. To speed the salvage work GE called on technicians and flood specialists from various parts of its nationwide organization to assist the local staff.

General Controls Co has purchased the assets of Grayson Greenmayer, Inc, Monrovia, Calif. The company has acquired Grayson-Greenmayer's line of automatic appliance controls and five acres of land including 30,000 sq ft of factory, foundry, and office space. Approximately $750,000 was involved in the transaction.

Prat-Daniel Corp, power plant equipment manufacturer, has moved from East Port Chester, Conn., to Norwalk, Conn.

Western Union Services, Inc, subsidiary of Western Union now installing and servicing television sets, is expanding its operations to include all standard makes of TV receivers. The present servicing territory of the company in New Jersey is being extended to take in Bergen and Hudson Counties in addition to Essex, Passaic, and Union Counties.

Admiral Corp plans to undertake a $7-million plant expansion program. Plans call for the construction of 500,-

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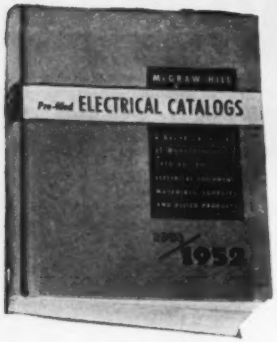

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000 additional sq ft of floor space at the Chicago and Galesburg factories and 240,000 sq ft at distribution centers in Chicago, New York, and Boston.

Nineteen professors from engineering colleges throughout the United States have spent their summer vacations working side by side with engineers and workmen of Westinghouse Electric Corp. The object of the company's Industrial Experience Program is the development of a more competent engineering graduate, one who can more easily make the transition from the campus to industry. Last week the professors joined other professors and Westinghouse officials at a seminar to discuss problems of engineering colleges and industry.

Kellex Corp, New York, specialist research and engineering firm, has changed its name to Vitro Corp of America. Its offices will remain at 233 Broadway, New York. The firm was purchased in June, 1950, by Vitro Manufacturing Co, Pittsburgh.

General Electric Co plans to build a factory in Springfield, N. J., as an addition to its precision laboratories plant at Irvington, N. J. The precision plant manufactures component parts for radio, television, and other electronic tubes. The new plant would double the size of the Irvington operation.

SALES ASSIGNMENTS

COMPANY STAFFS

Phelps Dodge Copper Products Corp has opened larger offices in St. Louis, Mo., in the Shell Building, 1221 Locust St. The offices will serve as headquarters for C. E. Borntraeger, district manager, and W. T. Wheeler and W. C. Schmieder, salesmen.

BullDog Electric Products Co, Detroit, has appointed John E. Tomes assistant Midwest division manager with headquarters in Chicago. William D. Hunt replaces Tomes as Detroit district sales manager.

Metal Prices
Aug. 20, 1951

COPPER, Conn., V., lb	$ .24½
LEAD, N. Y., lb	.17
ZINC, prime Western, E. St. Louis, lb	.17½
TIN, Straits, qual. N. Y. lb	1.03
ALUMINUM, ingot, base price	.19
NICKEL, base price	.56½
STEEL, billets, Pitts., ton	56.00
STEEL, scrap, No. 1 heavy, Pitts., ton	45.00

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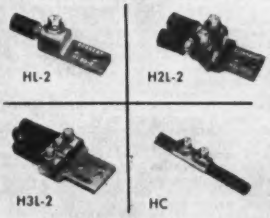

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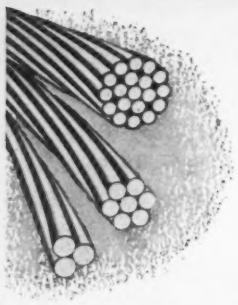

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NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Colorado—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, furnish., del. f.o.b. cars shipping point or f.o.b. cars Walt Siding, Colo., carload lots, Loveland, Colo., less than carloads lots, circuit breakers, switches, reactors, transformers for Flatiron Power and pumping Plant Switchyard and the Pole Hill Power Plant Switchyard, Colorado Big Thompson Proj. Spec. DS 3513. L. N. McClellan, ch. engr.

Fla., Orlando—U. S. Eng., P. O. Box 4970, Jacksonville, Fla. electrical distr. system, Pinecastle Air Force Base, Serial No. Eng 08-123-52-28.

Kansas—Great Plains Electric Co-operative, Colby, rural distr. lines, sys. imprvs., Thomas Co. $160,000. J. C. Leavitt Co., Garden City, consult. engr.

Kansas—United Telephone Assoc., Dodge City, exten., imprv. telephone sys. in Ford, Finney, Gray, Clark and Hodgeman Counties, $763,000.

La., Alexandria—City, power plant addn. Plans deposit $10. Soule Butler, city engr.

Mich., Lansing—Oldsmobile Div. General Motors Corp., J. F. Wolfram, mgr., 1014 Townsend St., 700,000 sq. ft. compressor and turbine unit, W. Saginaw St., $6,000,000. Argonaut Realty Div. General Motors Corp., General Motors Bldg., Detroit, archts.

Montana—Bureau Reclamation, Dept. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Louisville, five 115,000 volt, 1,200 ampere, 3,500,000 kva. interrupting rating, outdoor power circuit breakers; two 115,000 volt, 600 ampere, 3-pole, manually-gang-operated outdoor selector type switches with manually-gang-operated grounding blades on one side only; two 115,000 volt 600 ampere, 3-pole manually-gang-operated, outdoor selector-type switches, two 115,000 volt, 600 ampere, 3 pole, single-throw; manually-gang-operated outdoor disconnecting switches; four 115,000 volt insulated, 150,200 to 5 ampere, 60 cycle oil immersed, self-cooled, outdoor current transformers; three 15,000 volt insulated, 300 to 5 ampere 60 cycle, compound filled, self cooled, outdoor current transformers, four 115,000 volt insulated, 115,000 to 115 volt, 60 cycle, oil immersed, self-cooled, outdoor potential transformers; 9 single pole, earthquake proof, suspension type outdoor lightning arresters, 115,000 volt grounded neutral circuit for Canyon Ferry switchyard, Canyon Ferry Unit, Missouri River Basin Proj., Spec. DS 3519.

N. M., Sacramento Peak—U. S. Eng., P. O. Box 1538, Albuquerque, power transmission line from Cloudcroft to Sacramento Peak, approx. 17 mi. thru rugged terrain. Plans deposit $25.

O., Oxford—State Hy. Dpt. P. Wks., State Office Bldg., Columbus, power plant, boiler, sewage disposal, transmission lines, etc., Miami University. $287,900. H. G. Allen, state consult. State Office Bldg., Columbus engr. and archt.

Oregon—Lane County Electric Co-operative, 436 Charnelton St., Eugene, 20 mi. 115 kv transmission line. Plans deposit $10.

S. C., Moncks Corner—South Carolina Public Service Auth., Moncks Corners, S. C., steam electric plant imprvs. Ford, Bacon & Davis, 39 Broadway, New York, N. Y., engrs.

South Dakota—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Huron, Mt. Vernon, Sioux Falls and Watertown, one distribution board, composed of misc. alternating-current power board "DHA" and direct-current distribution board "BHA" incl. 2 battery chargers each for Huron, Mount Vernon, Sioux Falls and Watertown sub-stations, Inv. No. DS-3520.

Tenn., Tullahoma—U. S. Eng., Tulla-

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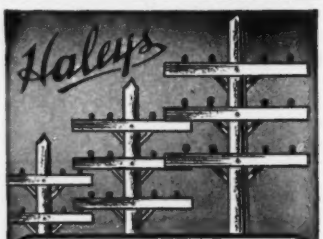

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homa, electric cable from power plant to main sub-station at Arnold Engineering Development Center. $250,000.

Texas—Brazos River Conservation & Reclamation Dist., c/o R. D. Collins, mgr., Mineral Wells, Breckenbridge Dam and hydro-electric power house; on Clear Fork of Brazos River, Proj. 41-P-1059, Haskell and Throckmorton Counties, $5,400,000; addnl. electric power units at De Cardova Bend Dam, Tex. 41-P-1060, Palo Pinto Co. $3,000,000; addnl. electric power units at Inspiration Point Dam, $2,550,000; addnl. electric power units at Possum Kingdom Dam, $3,750,000; Hightower Dam, hydro-electric power house and appurtenances on Brazos River in Hook and Parker Counties, Tex. 41-P-1047, $11,200,000, all foregoing near Mineral Wells; dam, hydro-electric power house and appurtenances on South Fork of Brazos River in Graham Young Co., Tex. 41-P-1058, $8,300,000. Ambursen Engineering Corp., 750 M & M Bldg., Houston, consult. engrs.

Tex., Victoria—Central Power & Light Co., 120 N. Chaparral St., Corpus Christie, overhead power lines, $100,000.

Vt., Swanton-Highgate Falls—Village of Swanton, municipal electric system imprvs., and addns., $842,000. Chas. T. Main, Inc., 80 Federal St., Boston, Mass., consult. engr.

Washington—U. S. Eng., 4735 E. Marginal Way, Seattle, Zone 4, three 19,600 hp. hydraulic turbine governors for Albeni Falls Dam, Inv., Civeng 52-1.

Alta., Grand Rapids—Alberta Power Conn., Terrace Bldg., Edmonton, power plant development on Lessor Slave River, approx. $2,000,000. B. Russell, dir. Water Resources Branch, Edmonton, engr.

Low Bidders & Contracts Awarded

Ill., Chicago—Ragner Benson, Inc., 4744 W. Rice St., Chicago 51, Ill., CA., $600,000. Plant No. 2 misc. imprvs. Electro-Motive Div. of General Motors Corp., 900 E. 103 St., Chicago, Ill.

Minn., Twin Lakes—Theo. J. Molzahn & Sons, Inc., 1812 Madison St., La Crosse, Wis. LB $185,000. Power Plant addn. Dairyland Power Co-operative, 407 Rivoli Bldg., La Crosse. Bids July 31.

N. J., Wrightstown—Fred J. Brotherton, 185 Atlantic St., Hackensack, N. J. CA, $734,876, electrical and navigation addns., McGuire Air Force Base, Fort Dix. Dpt. Army, 121 N. Broad St., Phila., Pa. Bids June 28.

Oregon—Allis-Chalmers Mfg. Co., 1126 S. 70 St., Milwaukee, Wis. LB $81,360 control switchboard, Detroit Dam Power house, CIVENG 35-026-51-307. U. S. Eng., Pittock Bldg., Portland, Ore.

Oregon—Pelton Water Wheel Co., 2929 19 St., San Francisco, Calif. LB $1,707,590. three turbines for Lookout Point Dam. CIVENG 35-026-51-310. U. S. Eng., 628 Pittock Block, Portland, Ore. Bids Aug. 8.

Tex., Port Lavaca—A. & H. Electrical Co., Inc., 3409 Agnes St., Corpus Christi, Tex. CA $689,000 electrical work, incl. outside lines, installation. Aluminum Co. of America, Port Lavaca, Tex. Awarded Aug. 11.

Tex., Victoria—Austin Building Co., 1000 Singleton Blvd., Dallas, Tex. and A. E. Hinman, 957 Navigation Blvd., Corpus Christi, Tex. CA $689,000. electric power plant unit. Central Power & Light Co., 120 N. Chaparral St., Corpus Christi.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Ala., Andalusia—Gulf Naval Stores Co., Gulfport, Miss., new plant, $1,700,000. Louis Latimer c/o owner, engr.

Ga., Bolton—Atlanta Paper Co., 950 W. Marietta St., Atlanta, paper board mill, $2,000,000.

Ill., Bradley—Armour & Co., U. S. Yards, Chicago, eight 1 story steel brick bldgs., pharmaceutical Laboratory $5,000,000. Holabird, Root & Burgee, 180 N. Wabash St., Chicago, archts.

Ill., Galesburg—Admiral Radio Corp., 3800 W. Cortland St., Chicago, 120,000 sq. ft. plant addn. $1,000,000.

Md., Lansdowne (Br. Baltimore)—Mardo Homes, Inc., 2 W. University Parkway, Baltimore, plans by Alexander S. Cochran, 411 N. Charles St., Baltimore, nine hundred suites, 2 story garden type apartment, 3 Ave. and Hollis Ferry Rd., $6,000,000.

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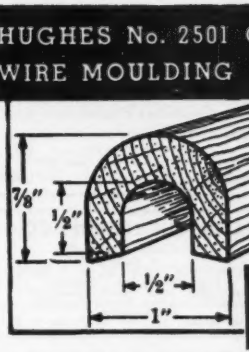

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3—250 KVA Kuhl 6600—575
3—200 KVA G-E 13200—120/240
3—100 KVA G-E 33000—6600/11950Y
3— 75 KVA G-E 11500—230/460
3— 50 KVA G-E 33000—2400/4160Y
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	KVA	Make	Type	Volts	Speed
1—	5140	Whse.		2400/4160	600

MOTOR GENERATOR SETS
3 ph. 60 cy.

Qu	KW	Make	Speed	DC Volts	AC Volts
2—	2000	G.E.	500	666.25 cy.	11000
1—	1500	G.E.	720	600	13200
1—	1500	G.E.	360	275	2200-4400
1—	1000	Whse.	900	600	4150
1—	1000	G.E.	450	260	4100-6900
1—	750	Whse.	900	275	2300-4150
2—	500	Whse.	900	250	6000/13200
1—	500	Whse.	1200	125/250	2300
1—	500	G.E.	900	600	2300/4000
1—	500	Whse.	900	250	440
1—	500	G.E.	720	125	2300
1—	400	G.E.	720	250	440-2300
1—	250	G.E.	900	125	4150

TRANSFORMERS—60 Cycle

	KVA	Make	Type	Ph	Volt ages
2—	4000	G.E.	HT	3	22000x2300
4—	2500	Mal.	O15C	1	69000x13800
2—	1250	G.E.	HVHDJ	1	6600x550
4—	333	G.E.	HKDD	1	13800 6900x230/460
6—	300	G.E.	HT	3	2400x240/480

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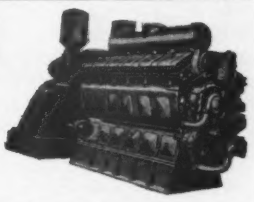

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1875	Fairbanks Morse	32F16	2000	300	375	Enterprise	DSG-6	450	480
1420	Fairbanks Morse	38D8⅛	1600	720	330	Superior	KNA	396	514
1250	General Motors	16-278A	1600	720	312	General Motors	8-268A	450	1200
937.5	General Motors	12-567	1080	720	312	Clark	MD-4	375	327
625	Alco	6-12½x13T	750	600	125	Ingersoll Rand	S	225	514
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400	Buckeye	80	480	600	75	General Motors	6043C	90	1200

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1— 200 KVA G.E., 3 Ph., 2400V 220 Sec.
1— 50 KVA G.E., 1 Ph., 2200V/6600V-220/440
1— 50 KVA G.E., 1 Ph., 13,800V, 120/240 Sec.
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LETTERS TO THE EDITOR

Gloves with Hot-line Tools

To the Editor:

In the Technical Notes of the July 9, 1951 issue of the Electrical World a comment is made in regard to two advantages of handling hot line tools with bare hands, greater dexterity and warning of brush discharge.

The practice of using hot line tools with bare hands is quite common and universal on transmission line voltages. On distribution voltages, however, it is not uncommon to require the use of rubber gloves or rubber gloves and sleeves. The chief reason for this is the increase in hazard from accidental contact because of the reduced physical clearances encountered on distribution work due to more conductors and equipment on the pole in the work area.

We experienced a serious electric shock case less than a month ago when a lineman failed to wear his rubber gloves and sleeves while removing a hot line clamp with a hot stick and contacted a fused cutout with his unprotected hands.

It is a standard approved practice in our company to use rubber gloves and sleeves for hot stick work on voltages between 300 and 14,400 volts when within reaching or falling distance of energized conductors (part of rule 4.8 in our Accident Prevention Manual). "Rubber gloves, sleeves and goggles are also required when using a switch stick to operate disconnect switches and fused cutouts under most conditions (rule 4.10)."

I. R. Dohr
General Safety Engineer
Consumers Power Co.
Jackson, Mich.

Sorry Mr. Hibbard

To the Editor:

In your May 21, 1951 issue of Electrical World beginning on page 128 you have a tabulation entitled "New Electric Generating Facilities to be Installed 1951-54 Compiled by FPC as of March 31, 1951."

On the second page of this tabulation you show under Minnesota Power & Light Company that the "M. *D.* Hibbard plant" is to be completed in Duluth in 1951.

This should be the M. *L.* Hibbard plant . . .

M. L. Hibbard
President and General Manager
Minnesota Power & Light Company
Duluth 2, Minnesota

Editor's Note: Electrical World's profound apologies to M. L. Hibbard for the accidental misuse of a well-known name.

More About Engineers Pay

To the Editor:

I have read with considerable interest the article on page 82 of the July 30 issue of Electrical World, entitled "Don't Utilities Really Want Electrical Engineers" by R. C. Kloeffler, Professor and Head of Electrical Engineering Department, Kansas State College, Manhattan, Kansas. This article seems to be so far below the calibre of the usual Electrical World article that I am quite surprised in your publishing it without comment. There have been a number of other surveys made by various groups which are probably familiar to you and certainly available to you. In fact you have published other information which is quite contradictory to that contained in this article.

One inference that might be drawn from the report is that the graduates of Kansas State College are different from the graduates of other colleges, but I cannot feel that this is true. A very quick check on your part would indicate the lack of realism in the chart published. This shows the maximum median salary received by a graduate one year out of college as being approximately $2050 as a teacher, with all other classifications below this. I assume that the curves show median values and that there must have been a large number below the rates indicated. The 1946 Engineers Joint Council Survey showed the median rates for electrical engineers under 1 year to be $237 per month. 1950 graduates had no difficulty in starting at $3000 per year and 1951 graduates at a somewhat higher rate. Therefore when Prof. Kloeffler states that Kansas State College graduates one year out of college were receiving less than $2000 per year I doubt the accuracy of the survey he conducted.

Some of the other statements made in the body of the article appear to be of approximately the same order of accuracy as his chart. It would be interesting to know what caused this survey to be so completely at variance with the facts, and why such misleading information is published by Electrical World.

L. R. Gaty
Manager
Engineering Department
Philadelphia Electric Co

Editor's Note: Electrical World should have pointed out that the chart referred to is based on the average of all salaries received by graduates during *their* first year, second year, etc, out of college and regardless of whether they graduated in 1915 ($600 per year) or in 1948 ($3,600 per year).

Testing Bonneville Cable

To the Editor:

In the July 16, 1951 issue of Electrical World, the article on page 120 contains an error in the last sentence where it reads "11,000 megohms per 1000 ft or 11 megohms per ft." The correct way to express the result is 11,000 megohms—1000 ft. If any reference to feet is made it would be 11 million megohms-ft.

Insulation resistance is not proportional to length, rather it is proportional to the reciprocal of length. Hence we avoid the word "per" as misleading and use a dash instead.

Perhaps in the interests of simply correcting the article the introduction of the words "11 million megohms per ft" would be sufficient.

W. F. Lamela
Technical Manager
The Okonite Company
Passaic, New Jersey

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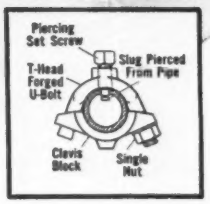

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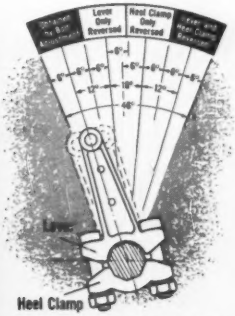

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